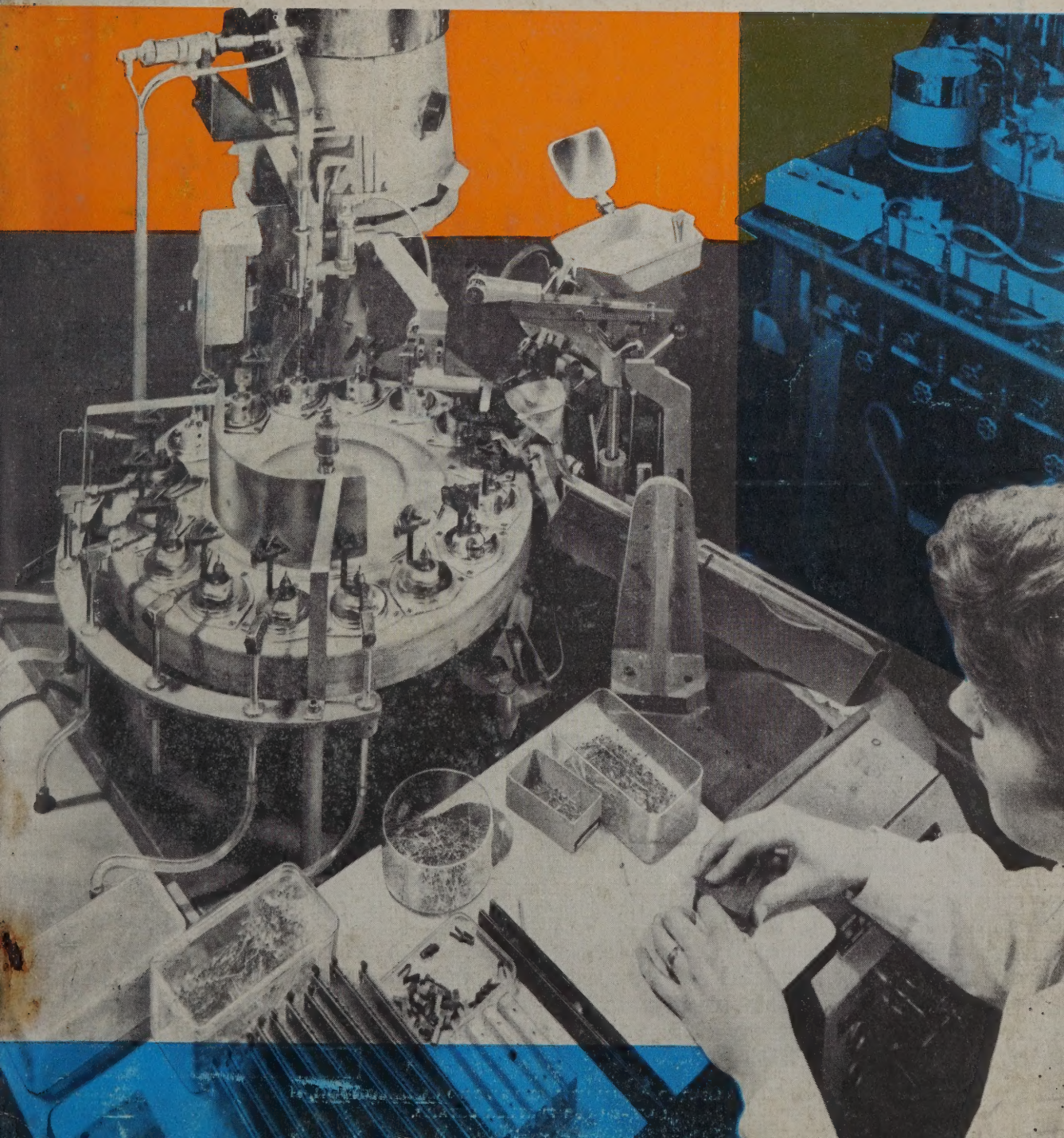
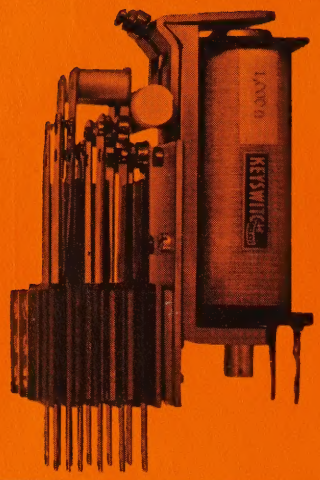
CALIBRATING THE W.W. OSCILLOSCOPE

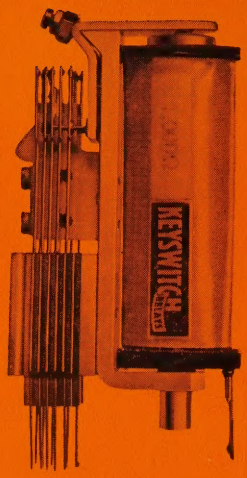
- ELECTRONICS
- TELEVISION
- RADIO • AUDIO

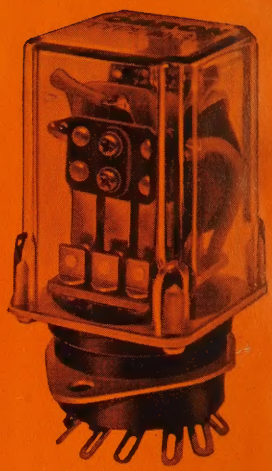
Wireless World

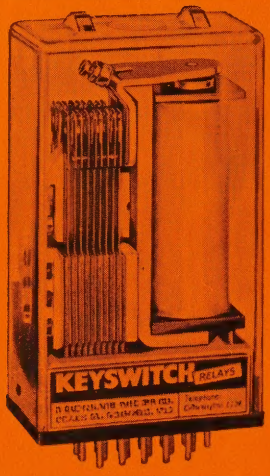
FEBRUARY 1964 Two Shillings and Sixpence



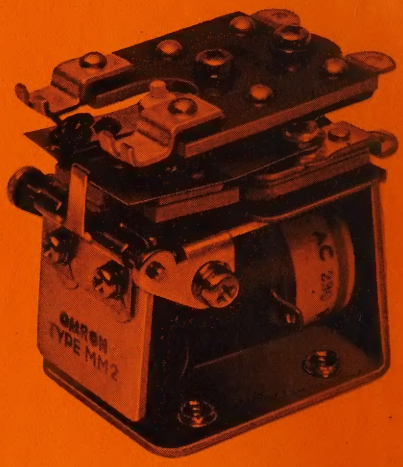


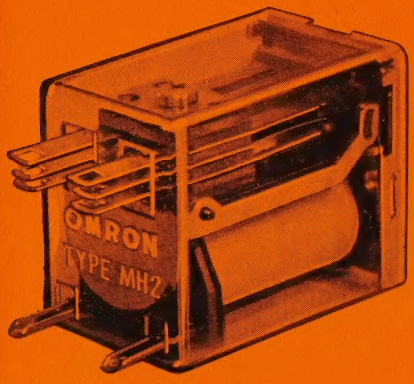


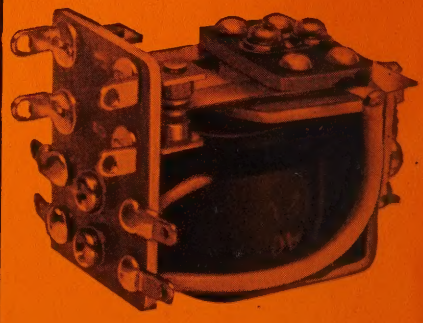




RELAYS DELIVERED 10 DAYS







KEYSWITCH AND OMRON GOLD RELAYS

Relays—thousands of them being manufactured and in stock now—covering all industrial and electronic control requirements. Compact, high quality, low-cost multi-pole switching, from milliamps to 30 amps per contact. Operating coil voltages from 6V to 440V a.c. and from less than 1V to 200V d.c.

KEYSWITCH RELAYS LTD

Details on request from: KEYSWITCH RELAYS LIMITED. 120-132 CRICKLEWOOD LANE, LONDON, N.W.2. Tel: GLAdstone 1152

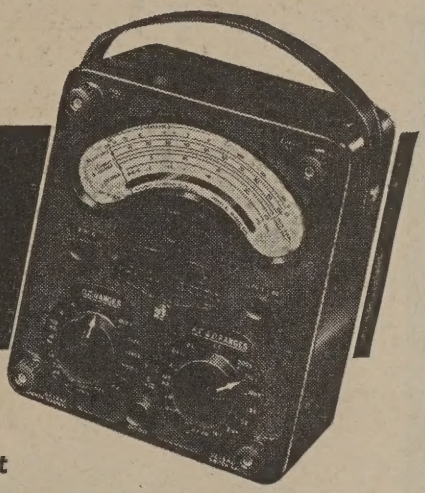
5WW-001 FOR FURTHER DETAILS.

NOW....

PROMPT DELIVERY

of

Model 8 AvoMeter



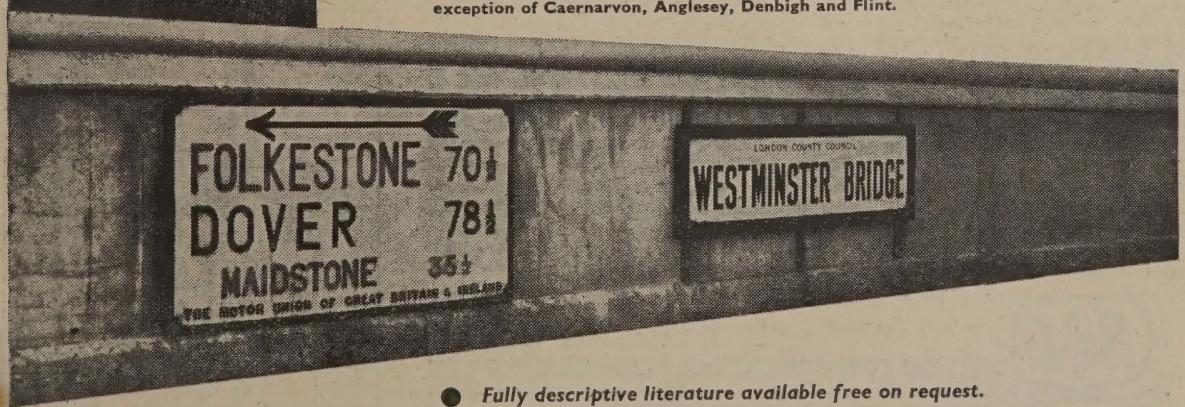
thanks to new production facilities at

DOVER *and* LONDON

The compulsion of continually increasing demand has urged us to achieve a more than corresponding increase in output of Model 8 AvoMeters. The combined facilities of our factories at Westminster and Dover are now such that deliveries can be effected promptly.

If you have urgent need of AvoMeters, please telephone. For forward deliveries, we, with the help of our Distributors, will deliver promptly to your time requirements.

Wireless Electric Limited of Bristol are Main Distributors of Avo Instruments for the following Counties: Hereford, Wiltshire, Dorset, Devon, Gloucester, Somerset, Hampshire, Cornwall, and all Wales with the exception of Caernarvon, Anglesey, Denbigh and Flint.



● *Fully descriptive literature available free on request.*

AVO LTD AVOCET HOUSE, 92-96 VAUXHALL BRIDGE ROAD, LONDON, S.W.1. *Victoria 3404 (12 lines)* M GROUP

A8/8

5WW—006 FOR FURTHER DETAILS.

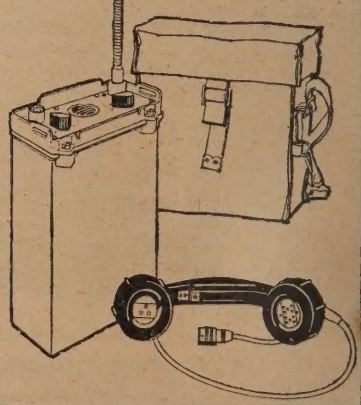
A

high performance

Museum Telephone Exchange and Radio Tower designed by the Chief Architect's Division of the Ministry of Public Building and Works Main Contractors Peter Lind & Co. Ltd.

The higher up the building goes, the more difficult becomes top-level contact with the ground. Wherever problems of communication are involved—such as are encountered in building the new GPO radio tower in London—the BCC 40 portable radiotelephone is the perfect answer.
Fully transistorised, compact and robust, with a proved consistently high performance, the BCC 40 is the natural choice for such undertakings. Designed for the particular needs of armed forces, police and fire services, it is ideal for use in industry where conditions are often equally arduous. The BCC 40 ensures reliable two-way speech communication and provides up to 6 channels in any of the VHF bands. There is also a choice of either P.M. or A.M. operation. The BCC 40 inherits the longstanding reputation of BCC equipments for high performance, reliability and endurance.

BCC40



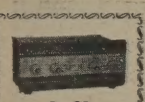
BCC

BRITISH COMMUNICATIONS CORPORATION LTD.

MEMBER OF THE CONTROLS AND COMMUNICATIONS GROUP

EXHIBITION GROUNDS, WEMBLEY, MIDDLESEX
Telephone: Wembley 1212 Telegrams: BEECEECEE WEMBLEY

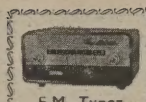
5WW—007 FOR FURTHER DETAILS.


S—33

Easy - to - build kit-sets of the

Heathkit
DAYSTROM

highest quality at lower cost


F.M. Tuner

5-W. STEREO AMPLIFIER KIT. Model S-33. 3 watts per channel, 0.3% distortion at 2.5 w/chnl., 20 dB N.F.B. Inputs for Radio (or Tape) and Gram., Stereo or Monaural, ganged controls. Sensitivity 200 mV. **£13 7 6**

6-W. HI-FI STEREO AMPLIFIER KIT. Model S-33H. An inexpensive stereo/mono amplifier with high sensitivity for lightweight miniature ceramic pick-ups (e.g. Decca Deram). Two-tone grey perspex panel. **£15 17 6**

5-W. HI-FI MONO AMPLIFIER KIT. Model MA-5. A general purpose amplifier based on the S-33. Separate bass and treble controls, gram and radio inputs. Suitable for most crystal pickups. Printed circuit **£10 19 6**

HI-FI STEREO AMPLIFIER KIT. Model S-99. 18 w. output. Ganged controls. Stereo/Monaural gram., radio and tape recorder inputs. Push-button selection. Grey metal cabinet. Printed circuit construction **£27 19 6**

HI-FI SINGLE-CHANNEL AMPLIFIER KIT. Model MA-12. 10 w. output, wide freq. range, low distortion **£11 18 0**

MONO CONTROL UNIT KIT. Model UMC-1. Ideal for use with MA-12 or similar amplifier. Output 0.25 v. **£8 12 6**

STEREO CONTROL UNIT KIT. Model USC-1. Push-button selection accurately matched ganged controls to ±1 dB. Accepts inputs from most tape heads and any stereo or mono pick-up **£19 10 0**

"GLOUCESTER" HI-FI CABINET KIT. Mk. I houses Record Player, F.M. Tuner, Stereo Amplifier, records, etc. Mk. II will house a Tape Deck, in addition. 46½in. long, 30in. high, 21in. deep. "In the white" for finish to personal taste. Mk. I **£17 3 6** Mk. II **£18 10 0**

"COTSWOLD" HI-FI SPEAKER SYSTEM KIT. Acoustically designed enclosure "in the white." 26in. x 23in. x 14½in. Complete with 12in. bass speaker with 2in. speech coil, elliptical middle speaker, pressure unit to cover the full frequency range of 30-20,000 c/s. Cross over unit, level control, etc. **£23 4 0**

"COTSWOLD MFS" SPEAKER SYSTEM KIT. Based on the standard Cotswold. Only 36in. high, 16½in. wide, 14in. deep. For those requiring best results in small rooms.... **£23 4 0**

"MALVERN" HI-FI EQUIPMENT CABINET KIT. Will house all your Hi-Fi equipment. "Left in the white" for finish to choice. Size 39⅛ x 32 x 21⅛in. **£18 1 0**

HI-FI SPEAKER SYSTEM KIT. Model SSU-1. Ducted-port bass reflex cabinet "in the white." Two speakers. With legs... **£11 12 0** Without legs **£10 17 6**

ELECTRONIC WORKSHOP KIT. Model EW-1. 20 exciting experiments can be made. No soldering. No extra tools needed **£7 13 6**

MULTIMETER KIT. Model MM-1U. Ranges 0-1.5 V. to 1,500 V. A.C. and D.C.; 150μA. to 15 A. D.C.; 0.2Ω to 20 MΩ. 4½in. 50μA. meter **£12 18 0**

RESISTANCE-CAPACITANCE BRIDGE KIT. Model C-3U. Measures cap. 10 pF to 1,000μF., res. 100Ω to 5 MΩ and power factor, 5-450 V. test voltages. With safety switch **£10 10 0**

AUDIO SIGNAL GENERATOR KIT. Model AG-9U. 10 c/s to 100 kc/s., switch selected. Distortion less than 0.1%. 10 v. sine wave output metered in volts and dB's. **£22 10 0**

AUDIO SINE-SQUARE WAVE GENERATOR KIT. Model AO-1U. Covers 20 c/s. to 150 kc/s. in four ranges with choice of sine or square waves. Size 9½in. x 6½in. x 5in. **£14 15 0**

New !

PUBLIC ADDRESS AMPLIFIER KIT. Model PA-1. A multi-purpose unit suitable for vocal and instrumental groups. 50W (100 pk) output. 4 inputs for guitars, mics., etc., two heavy-duty speakers, magic eye vol. indicator, variable tremolo, elegant cabinet. *Send for full details* **£54 15 0**

DECADE RESISTANCE BOX KIT. Model DR-1U. Range 1-99,999Ω in 1Ω steps. Ceramic switches throughout. Current rating from 500mA to 5mA. according to decades in circuit. Polished wooden cabinet supplied complete ... **£10 8 0**

5in. OSCILLOSCOPE KIT. Model O-12U. Has wide-band amplifiers, essential for TV servicing. F.M. alignment, etc. Vertical frequency response. 3 c/s to over 5 Mc/s., without extra switching. T/B covers 10 c/s. to 500 kc/s in 5 ranges. **£35 10 0**

ELECTRONIC SWITCH KIT. Model S-3U (Oscilloscope Trace Doubler). Enables a single beam oscilloscope to give simultaneous traces of two separate and independent signals. Switching rates approx. 150, 500, 1,500, 5,000 and 15,000 c/s. Sig. freq. response 0-100 kc/s. ±1 dB. Separate gain controls and sync. output. Sig. input range 0.1-1.8 v. r.m.s. **£12 18 0**

STABILISED POWER PACK KIT. Models MSP-1M and MSP-1W. Input 200-250 v., 40-60 c/s. A.C., fully fused. Outputs: H.T. 200-410V D.C. at 20-225 mA. in 3 switched ranges. Size 13in. x 8½in. x 9½in.
MSP-1M (with meters) **£36 12 6**
MSP-1W (without meters) **£29 17 6**

DECADE CAPACITOR KIT. Model DC-1. Capacity values 100μμF to 0.111μF in 100μμF steps **£7 5 0**

VALVE VOLTMETER KIT. Model V-7A. 7 voltage ranges d.c. volts to 1,500 a.c. to 1,500 r.m.s. and 4,000 peak to peak. Resistance 0.1Ω to 1,000 MΩ with internal battery. D.C. input impedance 11 MΩ. dB measurement has centre-zero scale. Complete with test prods, leads and standardising battery **£13 18 6**

R.F. PROBE KIT. Model 309-CU. For use with Model V-7A **£1 13 6**

HIGH VOLTAGE PROBE KIT. Model HV-336. For use with Model V-7A... **£2 19 6**

R.F. SIGNAL GENERATOR KIT. Model RF-1U. Provides extended frequency coverage on six bands from 100 kc/s-100 Mc/s. on fundamentals and up to 200 Mc/s on calibrated harmonics **£13 8 0**

GRID-DIP METER KIT. Model GD-1U. Functions as oscillator or absorption wave meter. With plug-in coils for continuous frequency coverage from 1.8 Mc/s. to 250 Mc/s.... **£10 19 6** Additional Plug-in Coils Model 341-U extend coverage down to 350 kc/s. **17/6**

2¾in. SERVICE 'SCOPE KIT. Model OS-1. Light, compact, portable for service engineers. Dim. 5 x 8 x 14½in. long. Wt. 10½ lb.... **£21 18 0**

AUDIO VALVE MILLIVOLTMETER KIT. Model AV-3U. 1 mV. to 300 V A.C. 10 c/s to 400 kc/s. **£16 10 0**

INTERNATIONAL MAIL ORDER SCHEME
covering the American Heathkit range of 250 models.
Direct from U.S.A. to your U.K. address. Illustrated American catalogue and full details can be obtained from us for 1/- post paid.

Now available! **GENERAL COVERAGE COMMUNICATIONS RECEIVER KIT, Model RG-1.** Frequency coverage from 600 kc/s. to 1.5 Mc/s. and 1.7 Mc/s. to 32 Mc/s. in 6 switched bands. Many features include: Half-lattice crystal filter. Send for full details **£39 16 0**

AMATEUR BANDS RECEIVER KIT. Model RA-1. 10-160m. Half-lattice crystal filter. Switched USB, LSB for SSB.
Full details on request..... **£39 6 6**

Q MULTIPLIER KIT. Model QPM-1. A self-powered unit (220-250 v. 50-60 c/s) for use with communications receivers to provide both additional selectivity and signal rejection.
Model QPM-1 for 470 kc/s IF Either Model QPM-16 for 1.6 Mc/s IF Model **£8 10 0**

"MOHICAN" GENERAL COVERAGE RECEIVER KIT. Model GC-1U. Fully transistorised. Frequency coverage 580 kc/s. to 30 Mc/s. in five bands. Electrical band spread on five additional bands covers amateur frequencies from 80-10 m., B.F.O. tuning and Zener diode stabiliser. *Send for full details* **£39 17 6**

AMATEUR TRANSMITTER KIT. Model DX-100U. 150 w. D.C. input. Covers all amateur bands from 160-10 m. Self contained including Power Supply. Modulator and V.F.O. **£79 10 0**

AMATEUR TRANSMITTER KIT. Model DX-40U. From 80-10 m. Crystal controlled. Power input 75 w. C.W. 60 w. peak controlled carrier phone. Output 40 w. to aerial. Provision for V.F.O. **£33 19 0**

SINGLE SIDEBAND ADAPTER KIT. Model SB-10U. May be used with most A.M. transmitters with certain provisions. Allows full use of existing equipment for SSB..... **£39 5 0**

VARIABLE FREQUENCY OSCILLATOR KIT. Model VF-1U. Calibrated 160-10 m. fundamentals on 160 and 40 m. Ideal for our DX-40U and similar transmitters **£12 10 0**

"OXFORD" DUAL-WAVE LUXURY TRANSISTOR PORTABLE RADIO KIT. Model UXR-2. Ideal as a domestic, car or personal receiver. *Send for full details* **£14 18 0**

4-WAVE TRANSISTORISED PORTABLE KIT. Model RSW-1. 7 Transistors and three diodes. For Short and Medium wavebands (200-550, 90-200, 20-40 and 11-16 m.) in solid leather case fitted with retractable whip aerial **£19 17 6**

TRANSISTOR PORTABLE RADIO KIT. Model UXR-1. Pre-aligned I.F. transformers' printed circuit and a 7 x 4in. high-flux speaker. Real hide case **£12 11 0**

A.M./F.M. TUNER KIT. Tuning range 88-108 Mc/s. (F.M.) 16-50, 200-550, 900-2,000 m A.M. Available in two units sold separately. Tuning Heart Model AFM-T1 **£4/13/6** inc. P.T. I.F. amplifier and Power Unit (AFM-A1). Complete with metal cabinet and valves **£21 16 6.** Total **£26 10 0**

HI-FI F.M. TUNER KIT. Tuning range 88-108 Mc/s. Available in two units sold separately as follows: Tuner Unit (FMT-4U) with 10.7 Mc/s. I.F. output **£2 15 0** inc. P.T. I.F. Amplifier and Power Supply (FMA-4U). Complete with case and valves **£13 3 0.** Total **£15 18 0**

TRANSISTOR INTERCOM. KITS. Models X1-1U and X1R-1U. Ideal for home or business use. Up to five Remote Stations operated with each Master. Units housed in mahogany veneered cabinets. 9 v. battery operated.
X1-1U (Master) **£10 19 6**
X1R-1U (Remote) **£4 7 6**

TELEPHONE AMPLIFIER KIT. Model TTA-1. Transistor circuit. Inductive pick-up coil, built-in speaker and vol. control **£7 9 6**

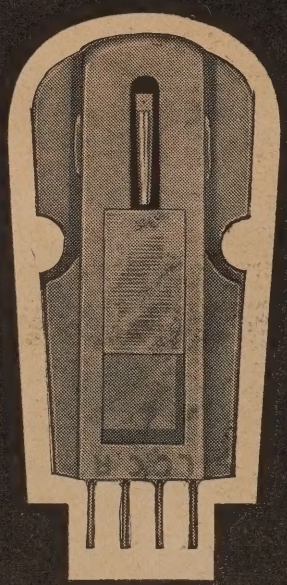
● Deferred Terms available on all orders above £10. ● Prices include free delivery in U.K. ● All models available assembled. Prices on request.

DAYSTROM LTD.
DEPT. W.W.2, GLOUCESTER, ENGLAND
A member of the Daystrom Group, Manufacturers of the
WORLD'S LARGEST-SELLING ELECTRONIC KIT-SETS

Please send me FREE CATALOGUE (Yes/No).....
Full details of model(s).....
NAME .....
(Block Capitals)
ADDRESS .....
..... W.W 2

5WW—008 FOR FURTHER DETAILS.

The shapes of sound



WATCH THE NEW GOLDRING C.S. 90!

A new Goldring Hi-Fi Cartridge is always something of an event. Great things were predicted for the 600 and 580 mono 'magnetics' and for the 700 stereo 'magnetic'... all now rated as top cartridges. Watch the new C.S. 90! It's a cartridge with a difference... a ceramic with the characteristics of a top quality magnetic! Tracking at 1½-3 grammes, it can be loaded straight into an amplifier with a sensitivity of 100 mV or more. The 0·0005″ diamond stylus is easily replaceable. Frequency response, compliance, signal/cross talk ratio, output... the figures are impressive: a full specification is yours for the asking. And the price? That's not least among the C.S. 90's merits: it costs just *four guineas* (+13/8 P.T.). Watch the C.S. 90... but don't wait to buy one!

CS 90
HI-FI STEREO
CERAMIC
SPECIAL
BY GOLDRING

GOLDRING MANUFACTURING CO. (G.B.) LIMITED, 486-488 HIGH ROAD, LEYTONSTONE, LONDON, E.11. TELEPHONE: LEYTONSTONE 8343

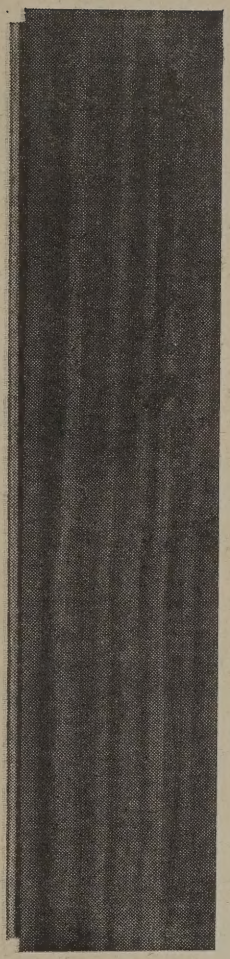
5WW—009 **FOR FURTHER DETAILS.**

Since its introduction the Eleganzia has become the most sought-after slim style High Fidelity Loudspeaker System. The Mark II Eleganzia now increases this lead still further with a smoother overall performance than ever before—still with no increase in the size, of the fantastically compact enclosure—2′ 3″ high, 1′ 8″ wide and only 6¼″ deep. Even the smallest living-room can accommodate an Eleganzia—or two for stereo—with no loss of useful living space; while the generous power handling will cater equally well for larger rooms or even for such occasions as public recitals.

The two loudspeakers in the Eleganzia are each the result of careful development by Goodmans experienced acoustic engineers, and have been specifically designed for operation in this very shallow enclosure.

Smoothly powerful performance has been combined with a dignified simplicity of styling to make the Eleganzia the most exciting slim High Fidelity Loudspeaker system ever.

Eleganzia II Price: **£27.10.0.**



GOOD looking
SUPERB listening

Slim Style ELEGANZIA II

15 WATT HIGH FIDELITY LOUDSPEAKER SYSTEM

GOODMANS **INDUSTRIES LIMITED**

Axiom Works Wembley Middlesex Tel: WEMbley 1200

A Member of the Relay Exchanges Group.

Please send me a free copy of the Goodmans High Fidelity Manual

Name.....

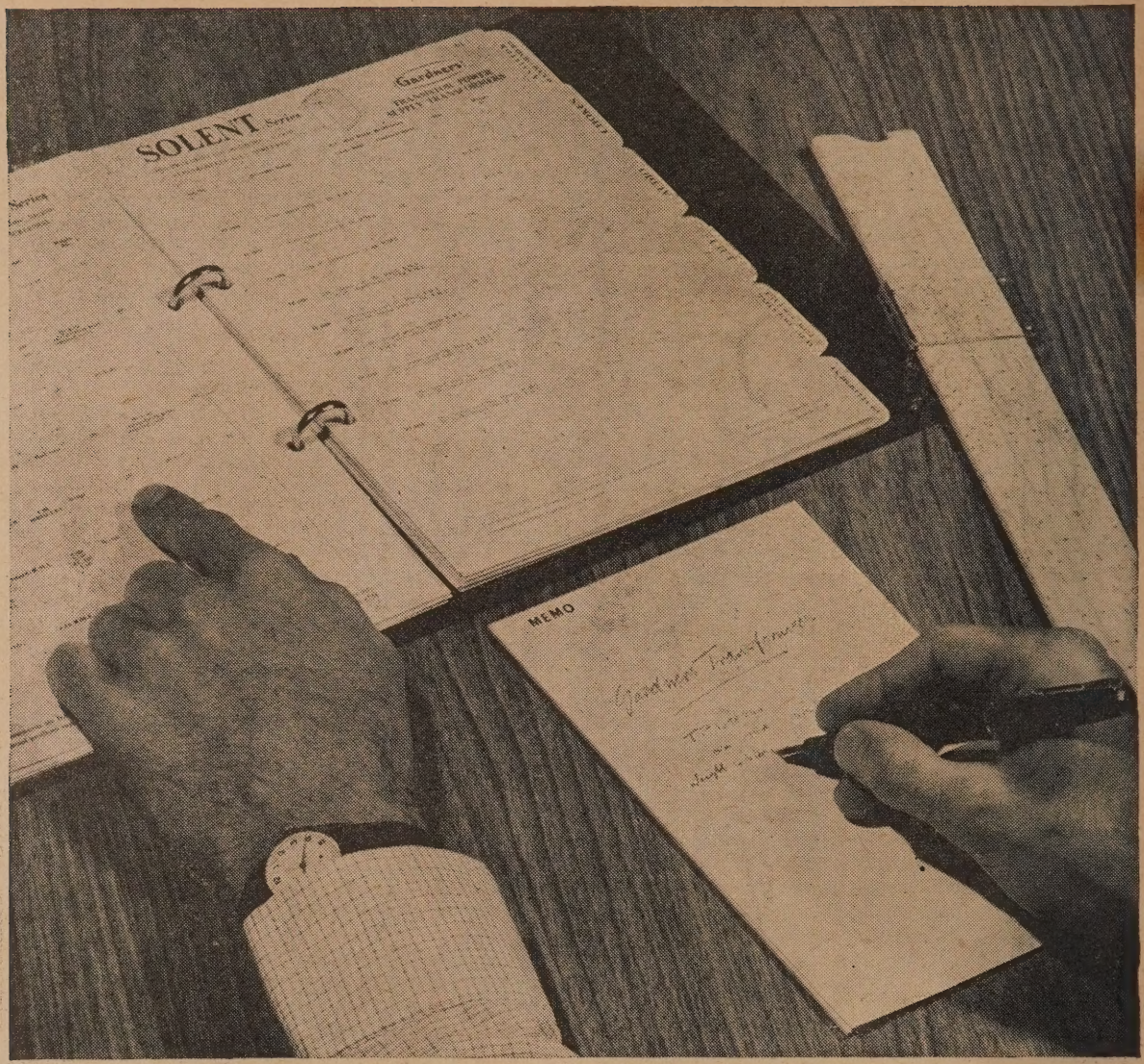
Address.....

.....

.....

WW2/64

5WW—010 FOR FURTHER DETAILS.



what's in this for me?...

If you are professionally engaged in the electronics industry you should have your own personal copy of Gardners Industrial Catalogue. It contains details of our latest additions—42 Transformers for Transistorised A/F Power Amplifiers, New Audio Line Matching Transformers, besides a comprehensive range of Small Power Transformers, Auto, Isolating and Low Voltage Transformers, Inductors, Saturable Reactors, etc.

This publication will be kept up to date with amendments and additions as they are issued. Years of specialisation have given Gardners Transformers a reputation for high performance and reliability.

Write for your copy of Gardners Industrial Catalogue on your company's heading. You will find it packed with the sort of information you require at your finger-tips.

Gardners
TRANSFORMERS for ELECTRONICS

GARDNERS TRANSFORMERS LIMITED
Somerford, Christchurch, Hants. Tel: 1734

to crow is one thing - to produce is another

5WW—011 FOR FURTHER DETAILS.

Continuous Frequency Coverage from 1·5 c/s to 150 kc/s in 5 Ranges at Decade Intervals

TRANSISTOR R.C. OSCILLATORS

TYPES TG 150, TG 150M TG 150D & TG 150DM

SPECIFICATION:

FREQUENCY
1.5 c/s to 150 kc/s
±3%+0.15 c/s.

STABILITY
<0.05% drift after 30 seconds.
<0.3% drift for 30% fall of supply voltage.
<0.05% drift per °C at 1 kc/s.

DISTORTION
<0.1% at 1 kc/s;
<0.3% from 50 c/s to 15 kc/s;
<1.5% below 50 c/s and above 15 kc/s.

SINE WAVE OUTPUT
Variable up to 2.5V into 600Ω
<1% variation with frequency.
<0.5% change for 30% fall of supply voltage.

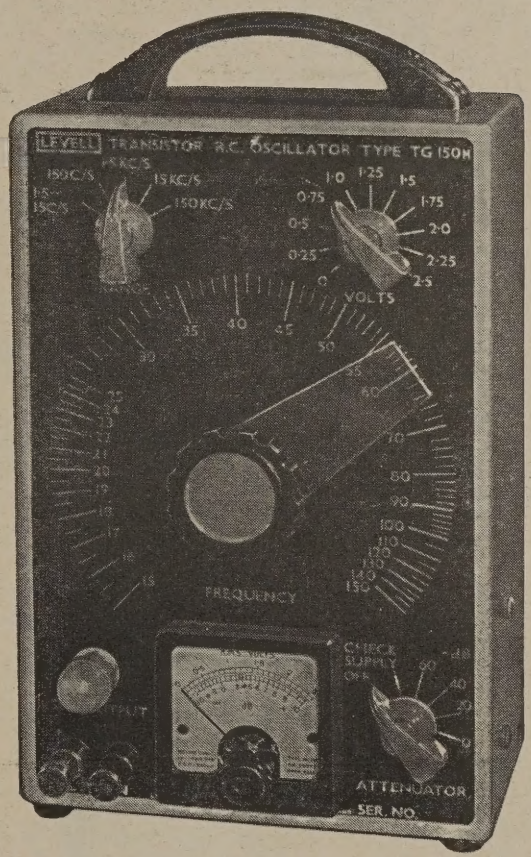
SQUARE WAVE OUTPUT
Variable up to 2.5V.
Rise time 1% of period +0.2μs

ATTENUATOR
20dB, 40dB and 60dB; 600Ω.

SUPPLY
Self-contained PP9 batteries, life 400 hours, or, 200/250V A.C. when Power Supply Unit is fitted.

SIZE
10in. high x 6in. wide x 4in. deep.

WEIGHT
6 pounds.



TYPE	TG 150	TG 150 M	TG 150 D	TG 150 DM
Output Waveforms:	Sine only	Sine only	Sine and Square	Sine and Square
Output Meter:	None	0-2.5V and dB	None	0-2.5V and dB
Price with batteries:	£32	£42	£35	£45

LEVELL
PORTABLE INSTRUMENTS

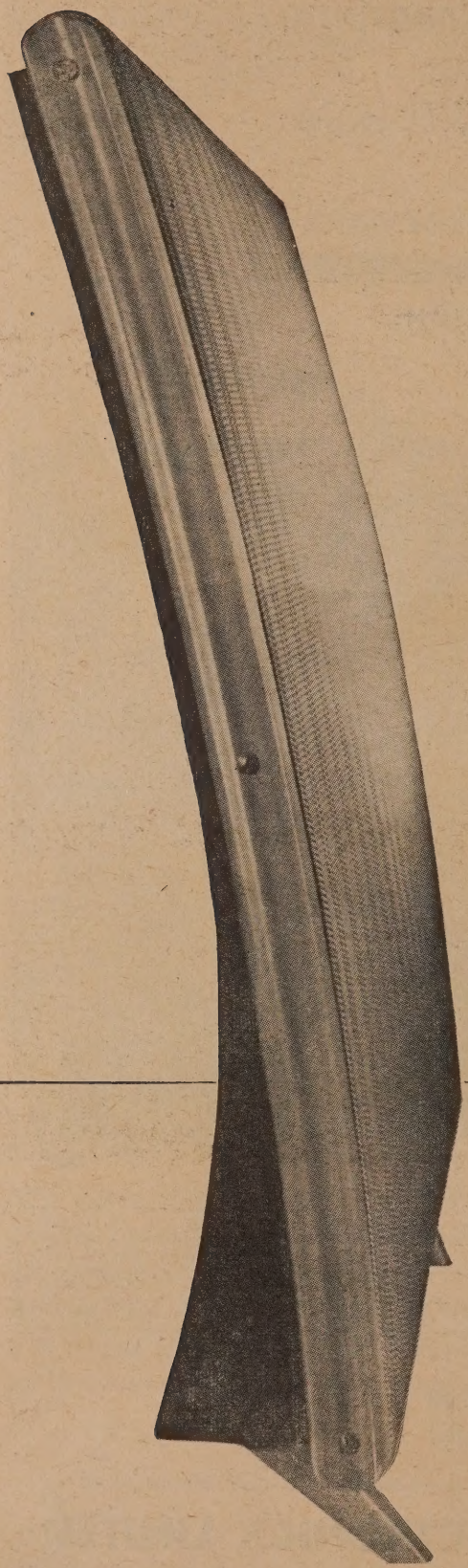
Mains Power Supply Unit **£7.10.0**
Leather carrying case **£3.10.0**

Fully detailed leaflets available on our complete range of portable instruments

LEVELL ELECTRONICS LIMITED

PARK ROAD, HIGH BARNET, HERTS——————Telephone: BARnet 5028

5WW—012 **FOR FURTHER DETAILS.**



completely lacking in character?

The depth probing Ad-men will shudder at the use of such a title but we can think of no better description for a good loudspeaker.
Character in the music; character in the instruments; character in the artist—yes, but no character in the loudspeaker, please!

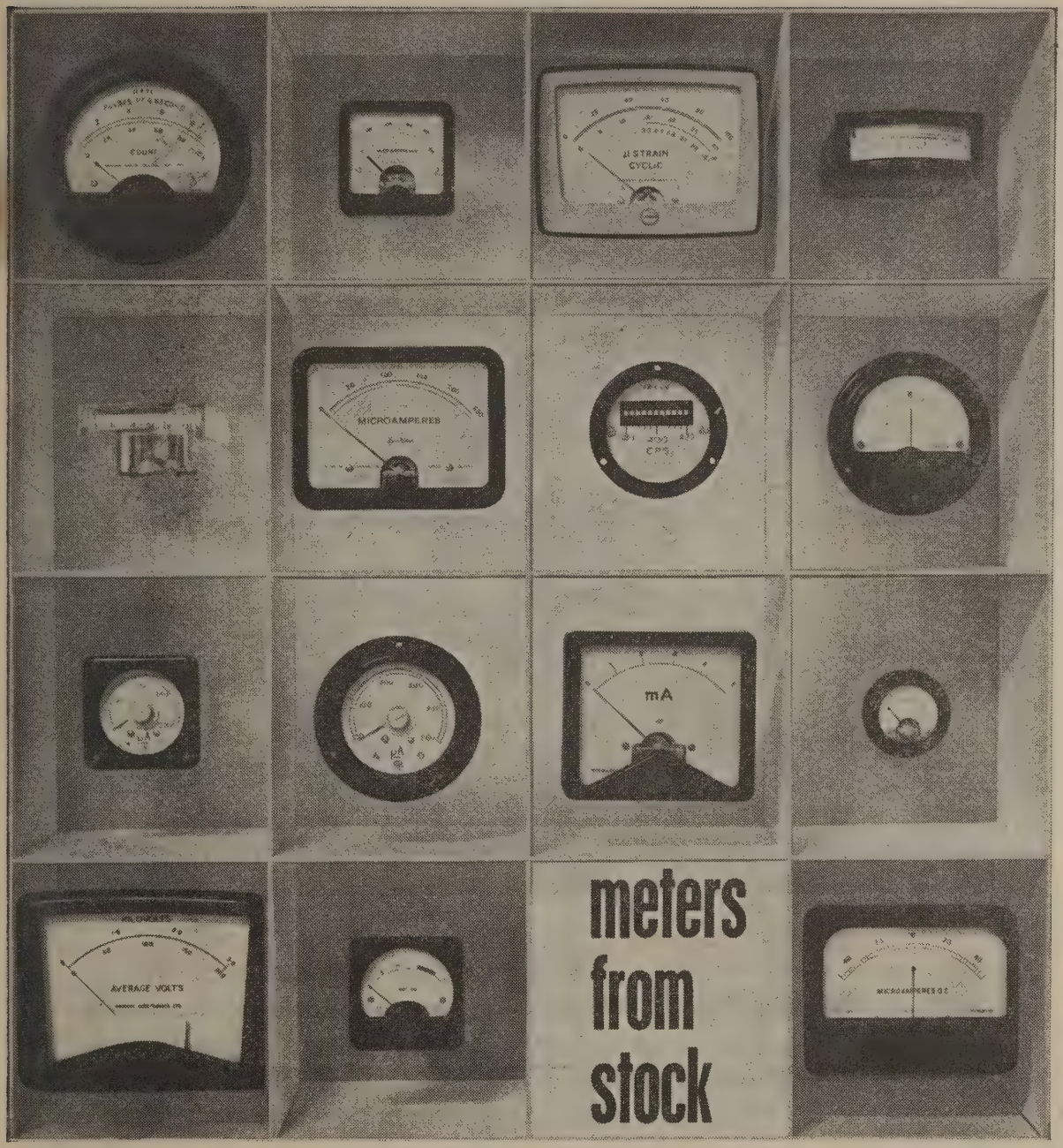
QUAD

for the closest approach to the original sound.

Send a postcard to Dept. WW for illustrated brochure.

ACOUSTICAL MANUFACTURING CO. LTD. HUNTINGDON, HUNTS. TEL: HUNTINGDON 361

5WW—013 FOR FURTHER DETAILS.



Anders carry enormous stocks of standard meters for immediate, off-the-shelf delivery. All well-known makes, including AVO, Crompton Parkinson, EAC, Elliott, Pullin, Sifam, Taylor, Turner, Weir, Weston, White; all types: moving coil, moving iron, thermocouples, electrostatic, dynamometers; the largest stock of panel mounting meters in the country; a complete range of accessories.

Non-standard meters of all types, specially calibrated to customers' requirements can speedily be supplied. The Anders Instrument Centre has unparalleled facilities for meeting the most urgent and unusual demands for any instrument, from miniature meters to the largest switchboard types.

Anders are sole agents in this country for the famous Frahm range of vibrating reed frequency meters and tachometers. 2½" miniature hermetically-sealed instruments to large panel-mounting meters with accuracies of 0.1%.

For full details of the Anders service, please write or 'phone

ANDERS ELECTRONICS LIMITED

103 HAMPSTEAD ROAD, LONDON N.W.1. TELEPHONE: EUSTON 1639

Contractors to GPO and Government Departments. Ministry of Aviation approved.

METERS, ELECTRONIC AND TEST EQUIPMENT TO INDIVIDUAL SPECIFICATIONS

5WW—014 FOR FURTHER DETAILS.

For resistors of the highest precision and smallest proportions, resistors for 'transistors', resistors for radar, radio astronomy or orbital flight—push the button marked Dubilier. For since the first bright spark crossed the gap and gave us wireless telegraphy, Dubilier have been an irresistible force in the resistor field. In those days the Dubilier resistor was a weighty affair. But as we grew, so its size diminished, until today you can get a dozen of the printed circuit types into a thimble without overcrowding. How small can they get? Why not ask Dubilier—after all, they started it.

DUBILIER Leaders in resistor development for more than fifty years

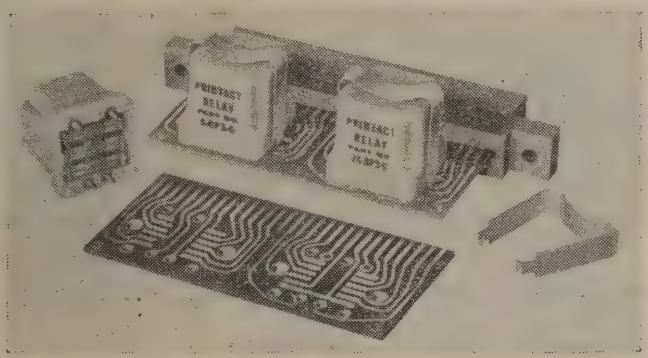
DUBILIER CONDENSER COMPANY (1925) LTD. Ducon Works, Victoria Rd., North Acton, London W.3
Phone: ACOrn 8671 (6 lines). Grams: Hivoltcon London Telex. Cables: Hivoltcon London (Marconi International Code). Telex 25373
5WW—015 FOR FURTHER DETAILS.

THE MIGHTY MIDGET

Complete in a $\frac{7}{8}$ in. cube

Weighs only 0·8 oz.

'Printact' Plug-in Printed Circuit Relay



- NO SPRINGS
- NO WIRING
- NO SOLDERING
- NO MECHANICAL LINKAGES
- NO EXPOSED PARTS

The highly reliable Printact Relay, which mounts on and becomes an integral part of your printed circuit board, makes possible substantial savings in space, weight and assembly costs. Mechanical linkage and fixed contacts on the relay are eliminated entirely. The moving contacts which are part of the armature assembly, mate with rhodium over nickel-plated copper conductors printed on your circuit board, Spring connectors on the coil leads eliminate soldering.

Fully encapsulated in a $\frac{7}{8}$in. high-impact plastic cube, the Printact relay employs a permanent magnet in place of a return spring to hold the armature open. The magnetic force remains constant eliminating the need for maintenance adjustment. Recommended configurations for your circuit layout, provide for switching up to three form A and B or form C, or up to five pole to a common line.

Coil resistance of the standard 6, 12 and 24 volt D.C. relays are 75,300 and 1,200 ohms (500 milliwatts) with pull-in occuring at 80% of rated voltage. Variations of coil resistance are available on special order.

Operating life exceeds 5,000,000 operations when contact load is from dry circuit up to $\frac{1}{4}$ amp 24 volts D.C.

Contact Material	Gold alloy or Palladium
Power Consumption	500 mw (at rated voltage)
Operating Temperature	−30°C to +95°C.
Operate Time	3 to 7 ms. at rated voltage
Dimensions and Weight	$\frac{7}{8} \times \frac{7}{8} \times \frac{13}{16}$—0.8 oz.
Dielectric Test	1000 volts RMS 60 cps.

Other Printact features include Bifurcated contacts: Double-break contacts; Balanced armature; Enclosed housing; Plug-in application; Encapsulated coil; Self-wiping contacts; Inherent snap action, greater switching versatility.

ALSO A LATCHING RELAY USING CERAMIC MAGNET

Cost of inexpensive latching Relay is less than half that of competitive relays because of "Printact" permanent ceramic magnet latching principle and balanced armature which eliminates all mechanical linkage. Reliability has been shown by mechanical life tests exceeding 10^5 cy and electrical tests exceeding 5×10^6 cy.

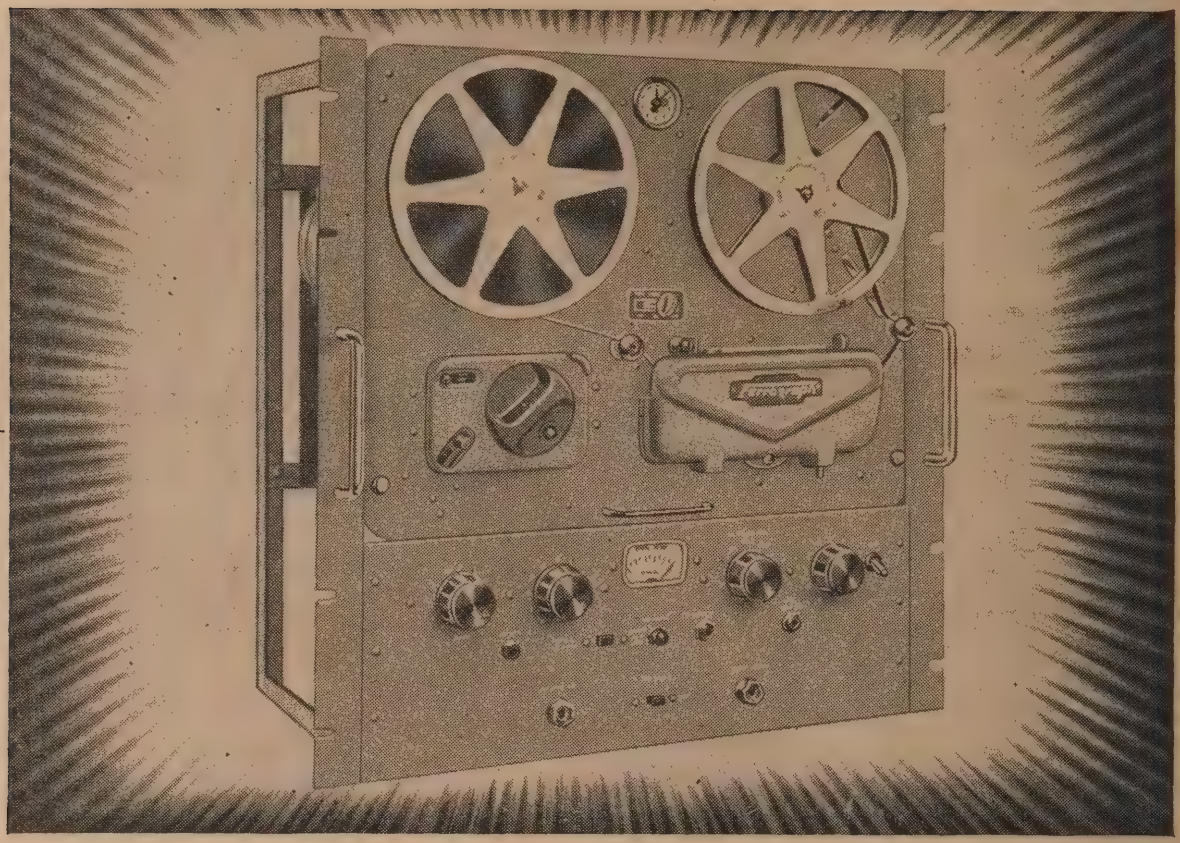
Available with single or double coil, relay features bifurcated contacts of gold alloy or palladium. D-c pulse of 7 ms duration at rated voltage will switch snap action relay. Single coil unit is rated 500 mw and switches d-c polarity to switch modes. Two-coil unit is rated 1-w and uses one coil for switching in and other for switching out.

Sole distributors for 'Printact' Relays:

A.D.S. RELAYS LTD.

89-97 St. John Street, London, E.C.1. *Tel: CLErkenwell 3393*

5WW—016 FOR FURTHER DETAILS.



Ferrograph

SERIES Y

RECORDERS

Series "Y" instruments are housed in strong metal cases and, in some instances, can be rack-mounted. They are intended for those engaged in scientific research and industrial pursuits.

YD5 SINGLE CHANNEL RECORDERS

Model	Tape Speeds	Voltage	Frequency
YD5A	7½, 3¾ and 1⅞ i.p.s.	100/250V	50 c.p.s.*
YD5AH	15 and 7½ i.p.s.	100/250V	50 c.p.s.*
YD5B	7½, 3¾ and 1⅞ i.p.s.	100/250V	50 c.p.s.*
YD5BH	15 and 7½ i.p.s.	100/250V	50 c.p.s.*

*60 c.p.s. to order

Y500 DOUBLE CHANNEL RECORDERS

Model	Tape Speeds	Voltage	Frequency
Y532U	7½, 3¾ and 1⅞ i.p.s.	200/250V	50 c.p.s.
Y532A	7½, 3¾ and 1⅞ i.p.s.	117V	60 c.p.s.
Y532E	7½, 3¾ and 1⅞ i.p.s.	110V	50 c.p.s.
Y522UH	15 and 7½ i.p.s.	200/250V	50 c.p.s.
Y522HA	15 and 7½ i.p.s.	117V	60 c.p.s.
Y522HE	15 and 7½ i.p.s.	110V	50 c.p.s.

SEND FOR DETAILS TO (Dept. W)

THE FERROGRAPH COMPANY LIMITED

84 Blackfriars Road, London, S.E.1 Telephone WATerloo 1981

5WW—017 FOR FURTHER DETAILS.

EXCEL in RADIO AND ELECTRONICS

AS A CAREER OR AS A FASCINATING HOBBY ...

THERE IS AN ICS COURSE FOR YOU!

By taking an ICS specialized home study course you gain a sound theoretical and practical knowledge of valve and transistor circuits and servicing work while building your own 5-valve receiver, transistor portable (or a.f. amplifier), signal generator and multi-test meter. *All under expert tuition!*

ICS Construction Courses have been specially written and designed by experienced radio engineers to enable YOU to learn easily and quickly, in you own home, in your own time.

ICS training will take you from basic principles to advanced applications of various circuits, all made up from the kits supplied.

With the ICS Complete Radio and Electronics Construction Course you get SIX kits, including testing instruments, tools and first class components. And, what is most important, a personal library of Instruction Manuals.

If you are making a career in the Radio industry, you will be interested in the wide range of examination and specialist diploma courses offered by ICS. These include:—

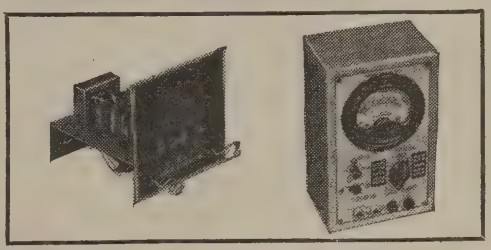
Radio and Television Engineering, Industrial Television, Radio and Television Servicing, Colour Television, Electronic Technicians, Servomechanisms, Radio-Electronic Telemetry, Instrumentation, Principles of Automation, Calculus for Electronics, Digital and Analogue Computers.

Specialized coaching for Grad. Brit. I.R.E., City and Guilds Telecommunication Technicians' Cert., Radio and T.V. Servicing Cert. (R.T.E.B.), P.M.G. Certs. and Radio Amateurs' exam.

EXAMINATION STUDENTS COACHED UNTIL SUCCESSFUL

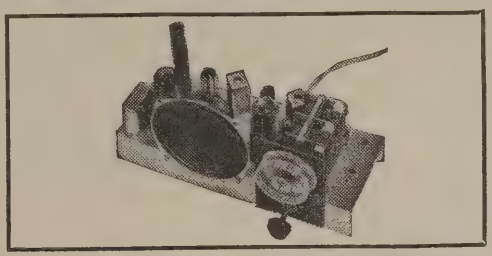
PRACTICAL INSTRUCTION!

1



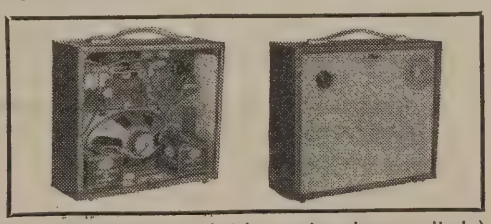
Assembly and use of signal generator and multi-test meter (especially valuable in servicing work).

2



Construction of 5-valve 2-waveband A.C./D.C. superheterodyne receiver, and a number of instructional experiments, using testing instruments.

3



Construction of 6-transistor (with semiconductor diode) 2 waveband portable, and a number of instructional experiments including a.f. amplifier with microphone pre-amplifier.

For full details of ICS Radio and Electronics Courses post coupon TODAY

ICS (DEPT. 225) INTERTEXT HOUSE, PARKGATE ROAD, LONDON, S.W.11

NAME.....

.....

ADDRESS .....

.....

.....

.....AGE.....2.64

INTERNATIONAL CORRESPONDENCE SCHOOLS

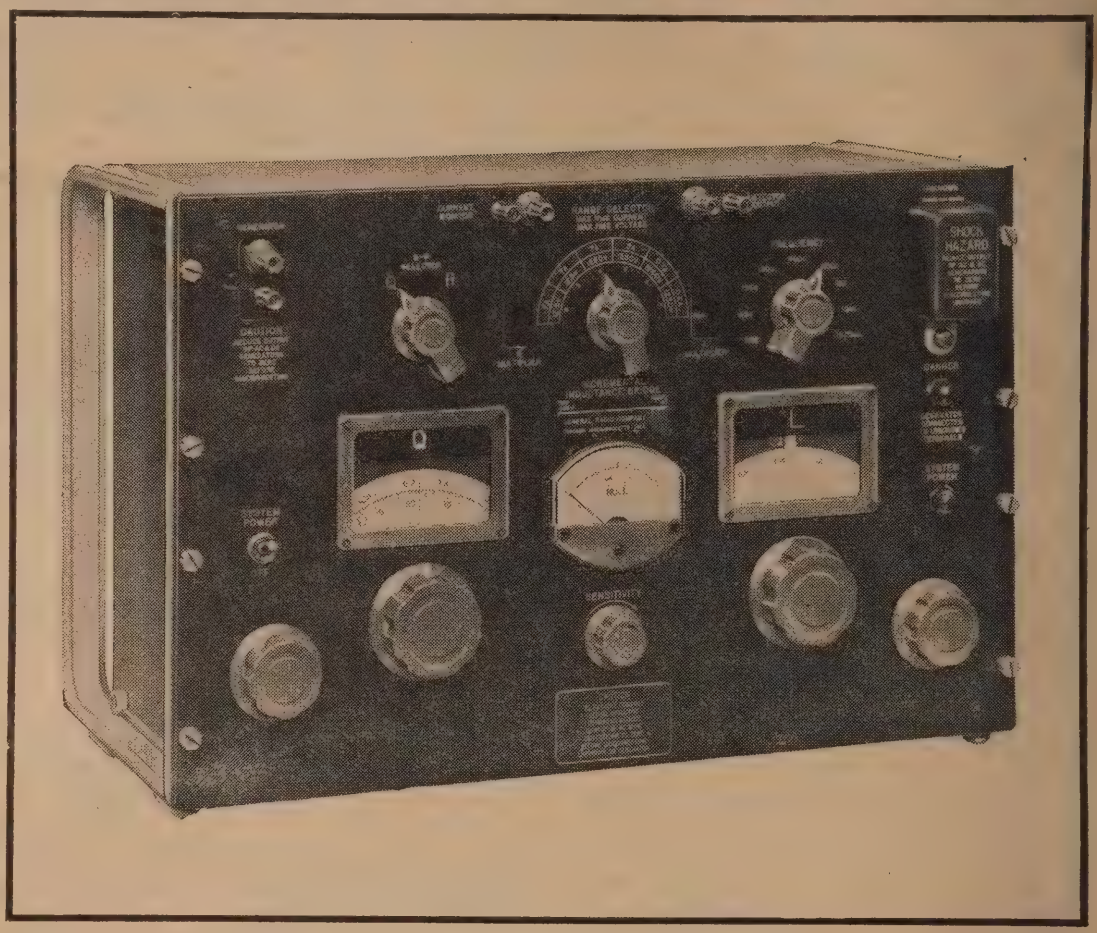
Member of the Association of British Correspondence Colleges

5WW—018 FOR FURTHER DETAILS.

NEW INCREMENTAL INDUCTANCE BRIDGE

MEASURES INDUCTANCES CARRYING UP TO 50 AMPERES D.C.

CLAUDE LYONS LIMITED



General Radio Type 1633-A Incremental-Inductance Bridge

This bridge will measure inductances from 0·2 μH to 1100 H carrying very heavy currents. It employs a unique circuit using transistorised operational amplifiers as active elements in the bridge arms. L and Q/R balances are independent, giving unequalled ease of operation. Essential to manufacturers and users of magnetic materials, ferrites, chokes, transformers and filters, the bridge is also valuable in measurement of non-linear resistances and semi-conductor devices.

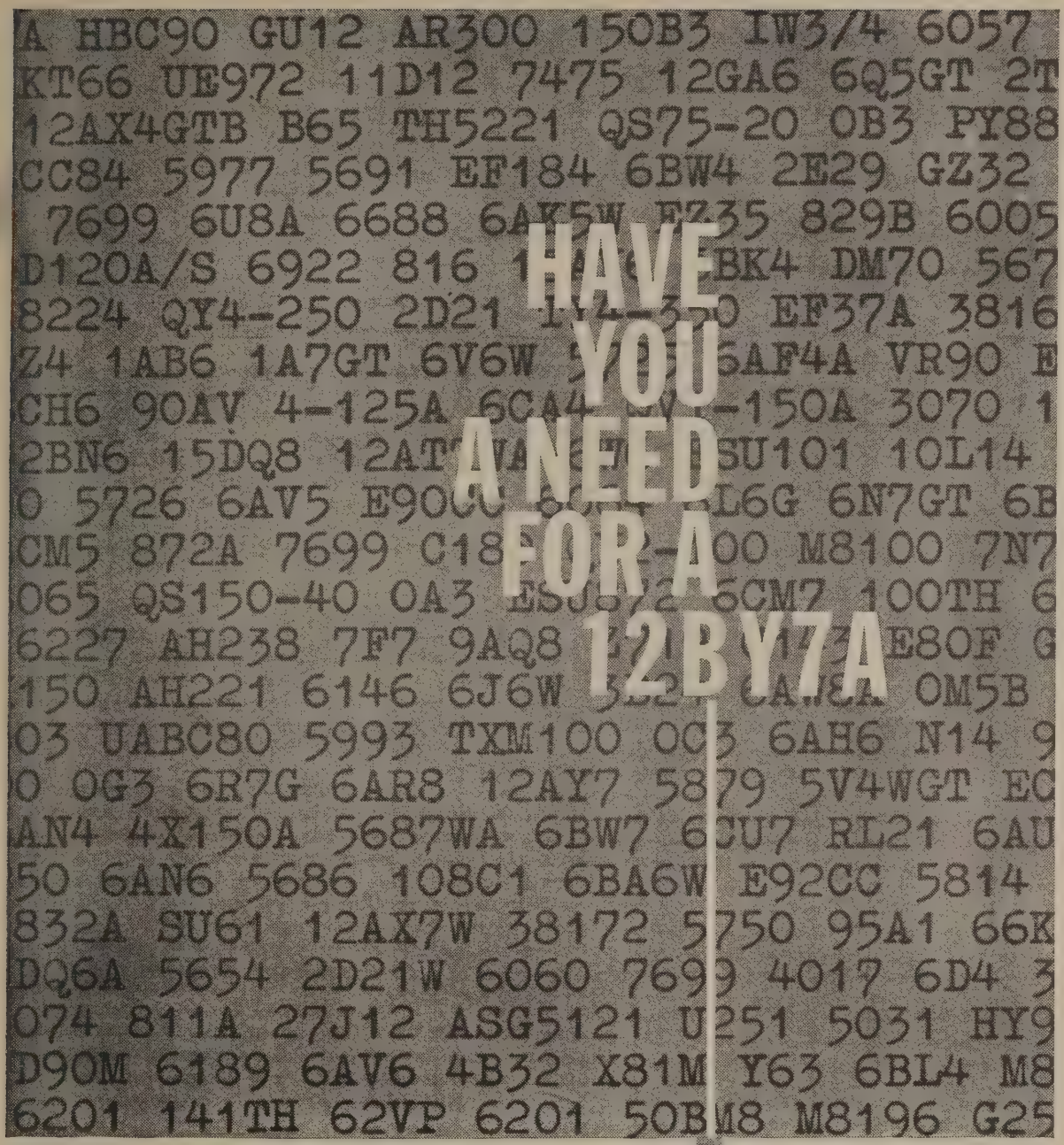
As the exclusive U.K. representatives, Claude Lyons Ltd will be glad to supply full technical details of General Radio precision electronic measuring instruments.

- Inductance range — 0·2 μH to 1100 H
- Resistance range — 10 mΩ to 1 MΩ
- Accuracy — ±0·1% of full scale for both L and R
- Frequency range — 20 c/s to 20 kc/s
- Internal detector tuned to nine frequencies from 50 c/s to 15·75 kc/s
- No sliding balance
- Bridge handles unknowns carrying up to 7 amps (RMS AC & DC) — up to 50 amps with 1633-P1 Extension Unit
- High current 50 c/s AC, 20 c/s - 20 kc/s AC, and DC power supplies available
- Price £405 net (duty free)

Exclusive representatives
Claude Lyons Limited, Instruments Division,
76 Old Hall Street, Liverpool 3. MARitime 1761

CL30/9506

5WW—019 **FOR FURTHER DETAILS.**



INDUSTRIAL VALVES

FOR INDUSTRY, EDUCATION AND RESEARCH.

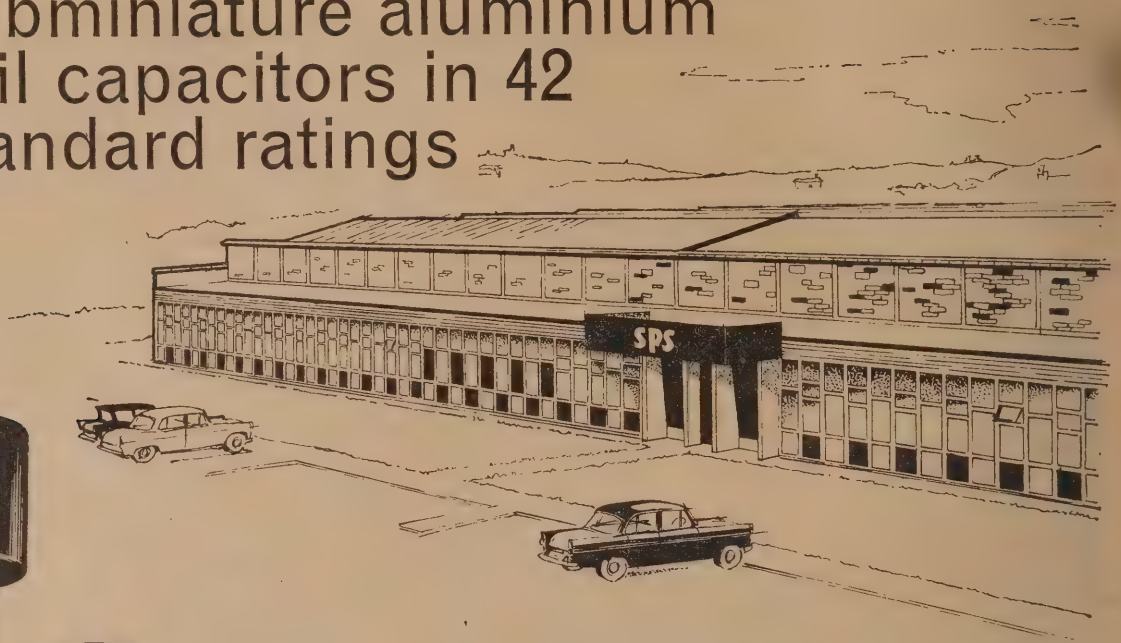
Pinnacle

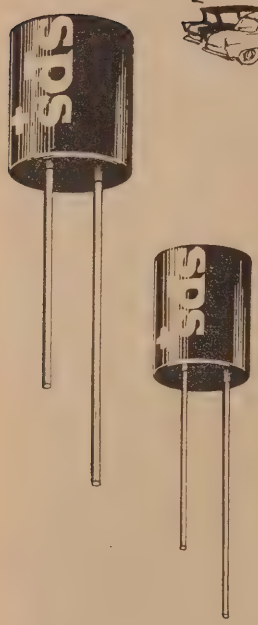
PINNACLE ELECTRONICS LIMITED.
27a Howland Street, London, W.1. LANgham 2311

5WW—020 FOR FURTHER DETAILS.

From Europe's most modern capacitor plant—

Subminiature aluminium Foil capacitors in 42 standard ratings





The most modern and efficient capacitors obtainable today.

For 8 years SPS International has been producing in the U.S.A. a range of miniature lightweight capacitors designed to cope with every extreme of temperature. Now the whole benefit of this experience has been brought to the new SPS factory at Shannon, Ireland, making the same high-quality capacitors available at short notice to any part of Britain. SPS capacitors guarantee complete reliability and long life thanks to the techniques of total encapsulation perfected over a long period in the U.S.A.

Ideal for transistorized communications equipment, portable radios, hearing aids, electronic instruments, audio cross-over networks, hi-fi tuners and amplifiers, recorders, test equipment and other low voltage circuits.

CAPACITANCE—20% + 100% of rated capacity

DISSIPATION FACTOR: Less than 8% at 50 WVDC
D.C. Leakage: Less than 6 μA after 1 min. applied WVDC

OPERATING TEMPERATURE: 65°C at rated WVDC

Available in 42 standard ratings, with intermediate values at no extra cost. For complete technical information and assistance write or telephone SPS International Ltd. European, manufacturing arm of a leading U.S. supplier of quality capacitors.

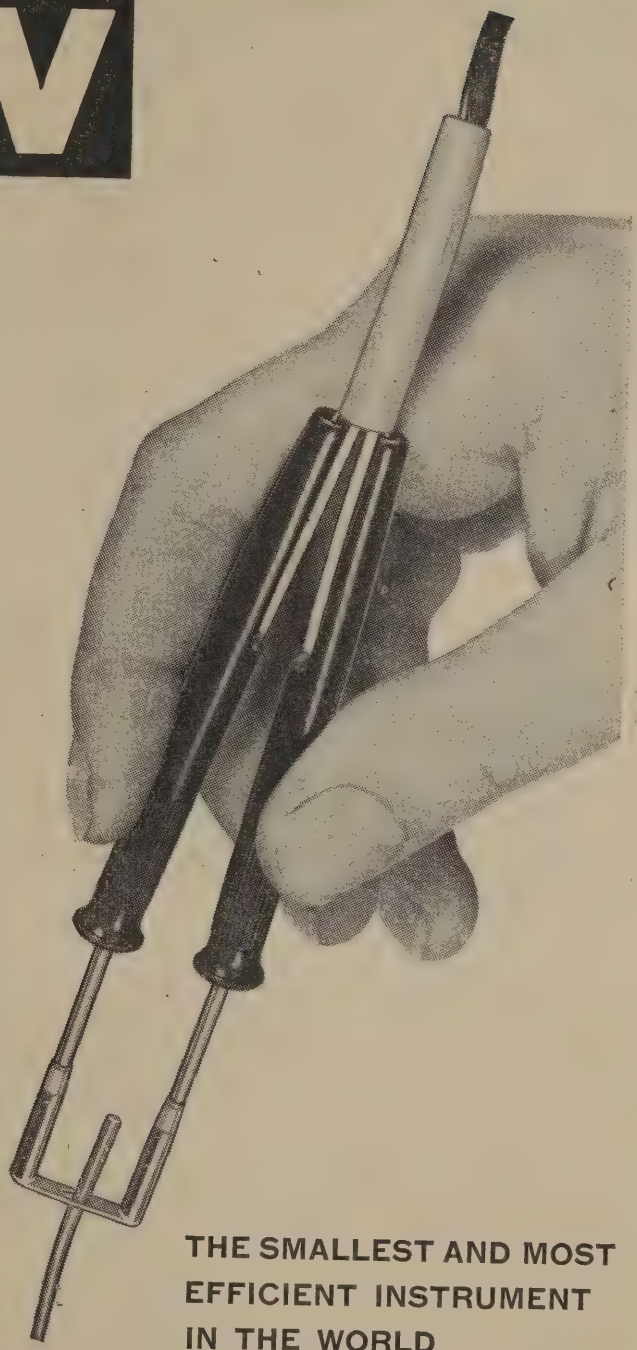
SPSI

SPS INTERNATIONAL LIMITED
SHANNON AIRPORT, IRELAND
Telephone: Shannon 245

5WW—021 FOR FURTHER DETAILS.

NEW

ORYX MINIATURE HEAT WIRE STRIPPERS



This new low voltage Duo-Thermal Wire Stripper has been designed to fill the need for speedy and efficient stripping of wire insulation such as PVC, Nylon, Rubber and Thermoplastics.

Two models are available:—

Micro-Miniature Stripper ST-6—accommodates wires of up to $\frac{1}{8}$in. (3 mm.) diameter, and operates at 250°C.

Miniature Stripper ST-18—accommodates wires of up to $\frac{1}{4}$in. (6 mm.) diameter and operates at 325°C.

Both models house a miniature heating element in each limb, total consumption for Model ST-6 being 12 watts and for Model ST-18 being 25 watts.

They are both available for 6 or 12 volt operation.

THE SMALLEST AND MOST EFFICIENT INSTRUMENT IN THE WORLD

SEND FOR ILLUSTRATED BROCHURE TO :—

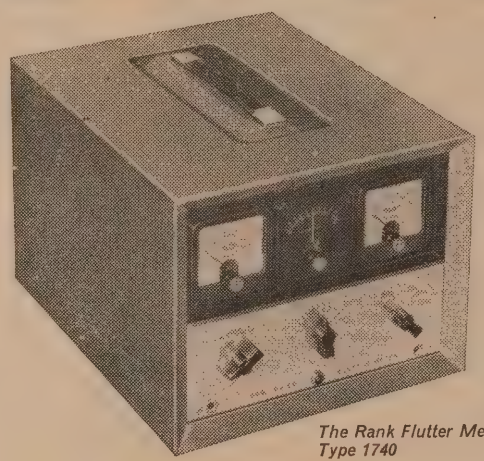
W. GREENWOOD
ELECTRONIC LTD
677 FINCHLEY ROAD LONDON N.W.2
Telephone:- SWISS COTTAGE 3383-4

DISTRIBUTORS FOR THE ORYX GROUP

5WW—022 FOR FURTHER DETAILS.

Why Rank FLUTTER meters are wanted around the world

Sound engineers say the Rank Flutter Meter measures speed variations most accurately. They find it equally suitable for machines employing perforated film, tape, or disc records. They describe it as light and compact. And the low price, they say, is as pleasing as the high performance. That is why Rank Flutter Meters are in demand wherever there is a 'Wow' or 'Flutter' to measure, and this is throughout the world.



The Rank Flutter Meter Type 1740

some users

B.B.C. Television and Research ▪ Birmingham Sound Reproducers Ltd. (U.K.) ▪ Collaro Ltd ▪ Commission Superieure Technique, Paris ▪ Commonwealth of Australia, Melbourne ▪ Compagnia Commerciale di Cinematografia, Milan ▪ Dept. Posts and Telegraph, Dublin ▪ Egyptian State Broadcasting ▪ E.M.I. Research Laboratories ▪ Garrard Engineering and Manufacturing Co. Ltd ▪ Magnavox Corporation of U.S.A. ▪ Marconi Wireless ▪ Ministry of Supply (U.K.) ▪ Ministry of Transport and Civil Aviation (U.K.) ▪ Mullard Ltd ▪ N.V. Philips' Gloeilampenfabrieken, Holland and Denmark ▪ N.Z. Broadcasting System ▪ Post Office Research Department ▪ R.C.A. Photophone Ltd ▪ Southern Instruments Ltd ▪ Truvox Ltd ▪ Vortexion Ltd ▪ Westrex Co. Ltd ▪ Wright & Weaire Ltd and users in India, Poland and Hong Kong.

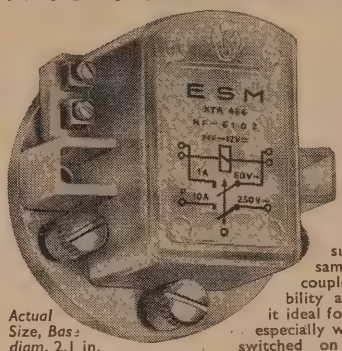
The Rank Organisation

RANK STUDIO EQUIPMENT

Woodger Rd. Shepherds Bush London W12 · Tel: SHEpherds Bush 2050

5WW—023 FOR FURTHER DETAILS.

HEAVY DUTY ESM—IMPULSE RELAY



Actual Size, Base diam. 2.1 in. (53 mm.). Height, 1.6 in. (40 mm.).

Rating at 0.3 power factor: Main Contact 10A, 250V. Auxiliary Contact 1A, 60V.

The ESM relay operates and releases its contacts on successive impulses on the same polarity. This feature coupled with exceptional reliability and high performance makes it ideal for remote control applications especially where the circuitry has to be switched on and/or off from different points.

As the relay can be provided with a special case for surface mounting and with an insertion box for flush mounting it becomes, therefore, most applicable also for many control duties in electrical installations such as small motor control, etc., etc. Furthermore, its low operating voltage affords economy in wiring costs, etc. It can also be used as a latching relay. The ESM-relay is also available as a conventional type whereby the usual contact arrangements normally open or normally closed can be combined with the auxiliary contact.

STANDARD 3000 TYPE RELAYS

BUILT TO SPECIFICATION

Quotations by Return of Post. Prototypes within 48 hours.

THE "REMANENCE" RELAY

● SPECIAL HIGH RETENTIVITY CORE

This is a 3000 type relay capable of latching in the energised position after the supply is removed, until a suitable releasing current is applied in the opposite direction. This releasing current is controlled by two methods:—

1. With a single coil, by reducing the operating current in reverse.
2. With a double coil, via a pair of contacts employed on the relay to energise the second coil.

Information on any contact arrangement to be employed can be obtained on application.

Ministry of Aviation Approved Inspection EID

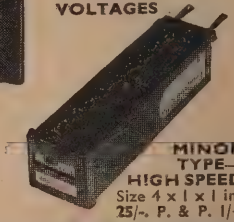
● RELAYS Type 600 ● Polarised ● AC Relays ● High Speed ● Uniselectors ● Latching Relays ● Magnetic Counters ● Miniature Sealed Relays. Available from stock or supplied to specification.

ELECTRO-MAGNETIC COUNTERS

TESTED AND GUARANTEED.

FOR ALL D.C. VOLTAGES

MAJOR TYPE Size 6 x 1½ x 1½in. 17/6. P. & P. 1/-.

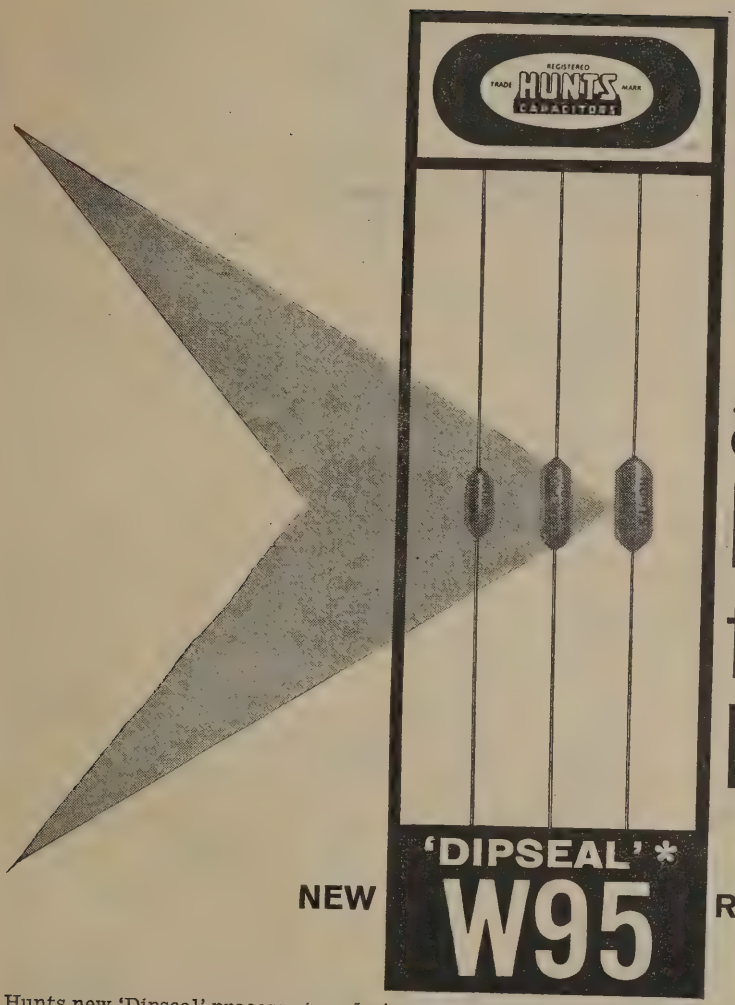


MINOR TYPE—HIGH SPEED Size 4 x 1 x 1 in 25/-. P. & P. 1/-.

Jack Davis (Relays) Ltd.

Dept. "W," 9/10, MALLOW STREET, OLD STREET, LONDON, E.C.1 Tel. CLErkenwell 3661/2

5WW—024 FOR FURTHER DETAILS.



another FIRST for HUNTS!

NEW 'DIPSEAL'* W95 RANGE

Hunts new 'Dipseal' process gives designers and service engineers a *new kind* of capacitor—a proven, reliable metallised paper unit in a tough, resinous housing. New 'Dipseal' W95 midget tubulars are as small as or smaller than their thermoplastic cased equivalents; the humidity performance is better; and the hard *thermosetting* resinous housing is unaffected by heat, making soldering safe and easy.
Find out more about the new W95 and other 'Dipseal' ranges. Full particulars will be sent freely on request.

- Better humidity performance than thermoplastic cased units.
- Far cheaper than metal cased units.

TYPE W95 STANDARD RANGE

D.C. Working Voltage	Capacitance (μF)	Dimensions
250	0.004 to 0.05	12 to 15.5mm x 5.5 to 6.5mm
500	0.002 to 0.01	
750	50pf to 0.004μF	

Temperature Range: −55°C to + 100°C Capacitance Tolerance ±20%

HUNTS

A. H. HUNT (Capacitors) LTD.
Wandsworth, London, S.W.18. Tel: VANdyke 6454
Factories also in Surrey, Sussex and North Wales

5WW—025 FOR FURTHER DETAILS.

4-Contact Precision PLUGS and JACKS

671 Plug complete with cable and Rubber Shroud

626 Socket complete with Cable and Rubber Shroud.

ASTRALUX LTD

CONTRACTORS TO H.M. GOVERNMENT A.I.D. AND A.R.B. APPROVED

PRECISION ELECTRICAL AND MECHANICAL ENGINEERS

NEW STREET BRIGHTLINGSEA COLCHESTER ESSEX

Tel Brightlingsea 417-8 *Grams Astralux Brightlingsea*

AIRCRAFT COMPONENT MANUFACTURERS AND STOCKISTS

should note that we manufacture and offer good delivery for the following items:

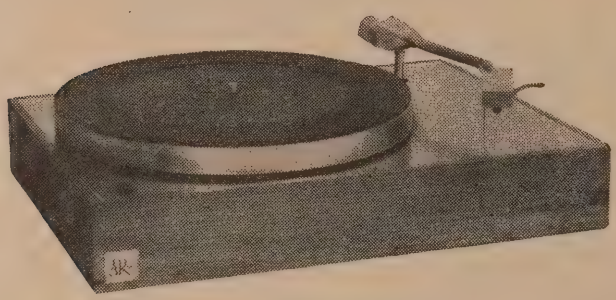
1. Mk. 2 Indicator Flow Oxygen instrument.
   Fluorised. Ref. 6D/743
   Luminised. Ref. 6D/232
2. Mk. 3A Indicator Flow Oxygen Instrument.
   Fluorised. Ref. 6D/1598
   Luminised. Ref. 6D/1597
3. Terminal Blocks Type 108. Ref. 10H/3780.
4. Pitot Pressure Head, Mk. 8T. Ref. 6A/3819.
5. Pitot Pressure Head. Mk. 8W. Ref. 6A/3820.
6. Clamps Securing for 3¼in. dia. Flangeless Instrument Case. Ref. 6A/4291.
7. Clamps Securing for 2in. dia. Flangeless Instrument Case. Ref. 6A/3823
8. Flange Adaptor for 2in. Case. Ref. 6A/4246.
9. Cable Clamp. Ref. 10H/19854.
10. Chokes—Hydraulic Type 1. Ref. 6A/1230.
11. Adaptor Plate—Type A. Ref. 6A/3305.
12. 671 Plugs and 626 Type Sockets. Ref. 10H/18575 and 10H/18574.
13. Plug Electrical. Ref. 5935-99-940-1767.
14. Aerial Mounting (Anti Flutter) Type 1014. Ref. 10AJ/191.
15. Omni Aerial Type 100B. Ref. 10B/20275.

Prices and delivery supplied on application. Please mention this publication when replying.

Enquiries also invited for: Electrical, Mechanical and Instrument Manufacture and/or Assembly. Electronic wiring component work. Precision Transformers. Vacuum and Open type Thermocouples. Precision Coil Winding. General Machining—up to max. of 6in. for turning. Small Development Jobs. Large or small batch work undertaken.

5WW—026 FOR FURTHER DETAILS.

ACOUSTIC RESEARCH TURNTABLE



NEW

PROFESSIONAL quality. The AR turntable meets NAB specifications for broadcast equipment on wow, flutter, rumble, and speed accuracy. It is belt-driven and synchronous.

PRICE

COMPLETE BUT LESS CARTRIDGE £47.5.0

FITTED WITH B&O STEREO CARTRIDGE £52.10.0

Also available fitted with cartridge of customers' choice and tested to professional standards

Deferred terms available

COMPLETE with arm, oiled walnut base, dust cover, and accessories including needle force gauge. Overall dimensions with the dust cover are 12¾" x 16¾" x 5¼".

STABLE performance. The suspension design makes it insensitive to mechanical shocks from the floor or to acoustic feedback.

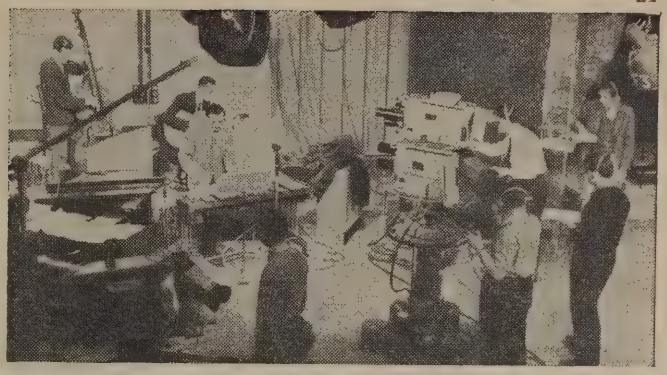
Stock delivery from :—

AUDIO DIVISION AVELEY ELECTRIC LTD. SOUTH OCKENDON, ESSEX

TELEX 24120 AVEL OCKENDON TELEPHONE SOUTH OCKENDON 3444

5WW—027 FOR FURTHER DETAILS.

When your work is worthy of the world's finest instruments . . .



Marconi Instruments
FM SIGNAL GENERATORS

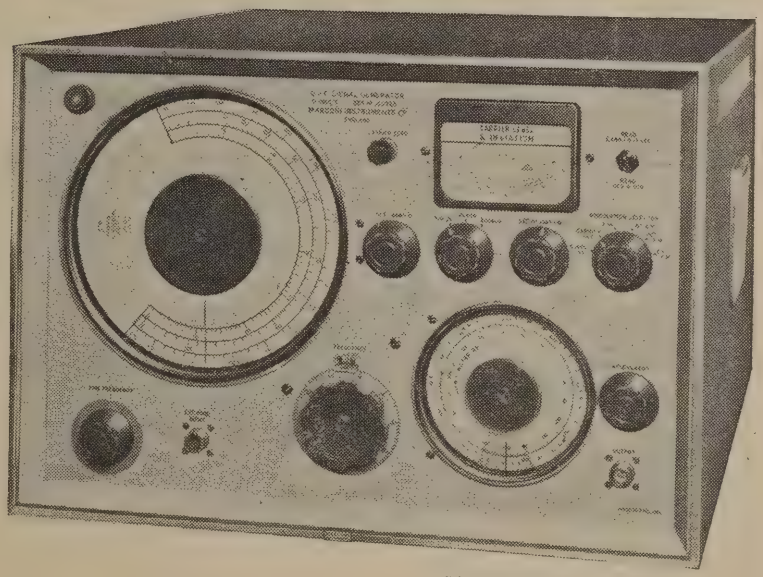
Two NEW versions of proven instruments

TYPE TF 1060/3

* Covers new television sound bands 4 and 5
* Frequency range: 470 to 960 Mc/s. Incremental and extra fine tuning
* Stability: 0.005% short term
* Output: 1μV to 0.5V at 50Ω
* FM deviation: 0 to 300 kc/s in 3 ranges
* Modulation frequency: 1 kc/s internal, 30 c/s to 100 kc/s external
* Internal AM: 30% fixed depth at 1 kc/s
* Bench or rack-mounting versions available
* Price: £460

TYPE TF 1066B/6

* Frequency range: 10 to 470 Mc/s in 5 bands, with crystal calibration. Direct reading. Stepped and continuously variable incremental tuning up to ±100 kc/s
* Output: 0.2 μV to 0.2V at 50Ω
* FM deviation: 0 to 100 kc/s. Up to 400 kc/s between 50 and 270 Mc/s. Monitored in three ranges
* Modulation frequency: 1 and 5 kc/s internal, 30 c/s to 100 kc/s external
* Bench or rack-mounting versions available
* Price: £450



TYPE TF 1060/3

Please write for full technical particulars. Address your enquiries to Marconi Instruments Limited at your nearest office.

A GOOD NAME FOR GOOD MEASURE

Area Offices:
English Electric House, Strand, London, W.C.2.
Telephone: COVent Garden 1234
40 Whiteladies Road, Bristol 8. Telephone: Bristol 39639
23/25 Station Square, Harrogate. Telephone: Harrogate 67454

Head Office—Home and Export Sales:
St. Albans, Herts., England. Telephone: St. Albans 59292

MARCONI INSTRUMENTS

5WW—028 FOR FURTHER DETAILS.

TC 237

FANE HIGH FIDELITY LOUDSPEAKERS

Full Range of Heavy Duty Types for All Purposes

CAST ALUMINIUM CHASSIS. EXTREMELY ROBUST 2in. DIAMETER VOICE COIL ASSEMBLIES

Model	Cone	Frequency response c.p.s.	Impedance ohms	Main resonance c.p.s.	Power handling watts R.M.S.	Flux density gauss	Total flux Maxwells	Voice coil winding	Diam. of Chassis	Baffle Hole	Net weight lbs.	Retail Price
122/10	Single	25–5000	15	32 or 75	20	10,000	100,000	Copper	12in.	11in.	6lbs.	5 gns.
122/10A	Dual	10–15000	15	32 or 75	20	10,000	100,000	Aluminium	12in.	11in.	6lbs.	6 gns.
122/12	Single	25–5000	15	32 or 75	20	12,000	160,000	Copper	12in.	11in.	6lbs.	£6/15/-
122/12A	Dual	30–15000	15	32 or 75	20	12,000	160,000	Aluminium	12in.	11in.	6lbs.	£7/19/6
122/14	Single	25–5000	15	32 or 75	22	14,000	186,000	Copper	12in.	11in.	7lbs.	9 gns.
122/14A	Dual	30–15000	15	32 or 75	22	14,000	186,000	Aluminium	12in.	11in.	7lbs.	10 gns.
122/17	Single	25–6000	15	32 or 75	25	17,000	226,000	Copper	12in.	11in.	10½lbs.	£11/17/6
122/17A	Dual	30–17000	15	32 or 75	25	17,000	226,000	Aluminium	12in.	11in.	10½lbs.	£12/17/6
152/12	Single	25–3500	15	30 or 75	20	12,000	160,000	Copper	15in.	13¼in.	8lbs.	12 gns.
152/12A	Dual	30–15000	15	30 or 75	20	12,000	160,000	Aluminium	15in.	13¼in.	8lbs.	13 gns.
152/14	Single	25–3500	15	30 or 75	22	14,000	186,000	Copper	15in.	13¼in.	9lbs.	14 gns.
152/14A	Dual	30–15000	15	30 or 75	22	14,000	186,000	Aluminium	15in.	13¼in.	9lbs.	15 gns.
152/17	Single	25–4000	15	30 or 75	25	17,000	226,000	Copper	15in.	13¼in.	12½lbs.	16 gns.
152/17A	Dual	30–17000	15	30 or 75	25	17,000	226,000	Aluminium	15in.	13¼in.	12½lbs.	17 gns.

EXTRA HEAVY DUTY TYPES WITH 3in. DIAMETER POLE PIECES

153	Single	30–3500	15	40 or 75	40	14,000	375,000	Copper	15in.	13¼in.	20lbs.	18 gns.
183	Single	20–3000	15	30 or 75	60	14,000	375,000	Copper	18in.	16¼in.	22lbs.	25 gns.

AVAILABLE THROUGH ALL SOUND EQUIPMENT STOCKISTS

Manufacturers' enquiries to:
FANE ACOUSTICS LTD.
HICK LANE : BATLEY, YORKS.

Sole distributors to Wholesale and Retail Trade:
LINEAR PRODUCTS LTD.
ELECTRON WORKS : ARMLEY, LEEDS

5WW—029 FOR FURTHER DETAILS.

NOMBREX INSTRUMENTATION

Wide-range Transistorised
SIGNAL GENERATOR—Model 27.
Range 150 Kc/s. to 350 Mc/s.
★ Accuracy better than 2%.
★ Directly calibrated.
★ Battery operated.
★ Compact and light.

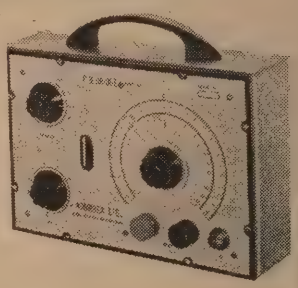
£9.12.3

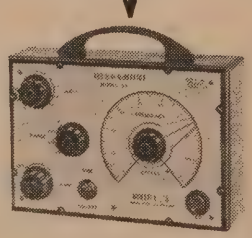
with test lead and battery. Post and packing 3/6 extra.
H.P. 48/- deposit and 27/- monthly.

Wide-Range Transistorised
AUDIO GENERATOR—MODEL 63
Range 10-100,000 c/s.
★ Laboratory Standard Specification.
★ Sine and Square Wave.
★ Direct Frequency Calibration.
★ Accuracy and Low Distortion.
★ Calibrated Output Voltage.
★ Battery Operated and Compact.

£16.15.0 complete with test lead.

Battery 2/3. Post & Pkg. 3/6.
H.P. 4 Gns. Deposit and 47/- monthly.





Wide Range Transistorised
C.R. BRIDGE—Model 62.
6 RANGES 1Ω to 100 MΩ
1pF to 100μF
★ Visual null indicator.
★ Power Factor check.
★ Electrolytic leakage test.
★ Battery operated.

£8.7.3

including battery. Post and Packing 3/6 extra.
H.P. 40/- deposit and 24/- monthly.

Trade and Export Enquiries Invited

S.A.E. For Full Technical Leaflets

NOMBREX LTD. **INSTRUMENTS DIVISION 72** **ESTUARY HOUSE, CAMPERDOWN TERRACE, EXMOUTH, DEVON. PHONE 3515**

5WW—030 FOR FURTHER DETAILS.

S·S·White Flexible SHAFTING for REMOTE CONTROL

If only we could tell you some of the problems we have solved for many major industrial concerns.

But we must be discreet . . . as discreet as we'll be if given an opportunity to discuss some problem of remote control with you.

Our technical handbook makes a very useful addition to a reference library. Write for copy to Dept. W.

S·S·White

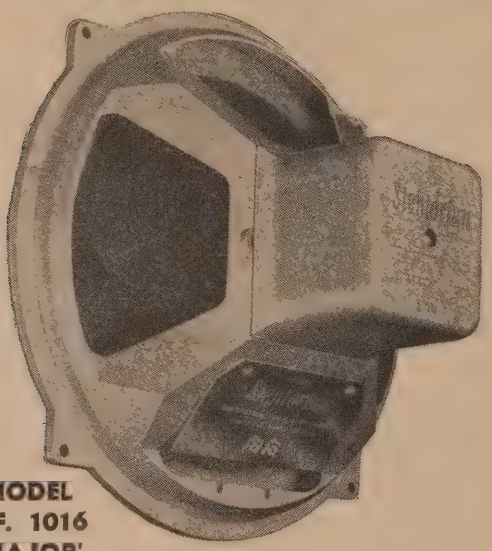
THE S. S. WHITE DENTAL MFG. CO. (G.B.) LTD.,
INDUSTRIAL DIVISION
Third Avenue, Denbigh Road, Bletchley, Bucks.

5WW—031 FOR FURTHER DETAILS.

R.C.11

Stentorian

THE SOUND OF TODAY!



MODEL H.F. 1016 'MAJOR'

This new unit makes use of the high flux density available in the magnet system of the previous H.F. 1016 unit. A curved diaphragm is used with a rigid centre section coupled to the voice coil. The rigid coupling and the design of the cone termination give a balanced response over the whole audio range. The unit is specially suitable for use in the smaller type of enclosure having a volume of approximately 1½ cubic feet.

Specification: Chassis—die cast aluminium; Cone—graded pulp cambric surround; Cone dia.—10in.; Pole dia.—1in.; Flux density—16,000 gauss; Total flux—64,000 maxwells; Impedance—15 ohms.

Price: £8. 19. 6

Other Stentorian Speakers

Type	Flux Density	Price
10″ H.F.1012*	12,000 gauss	£4 7 6
8″ H.F.816*	16,000 gauss	£6 0 0
8″ H.F.812*	12,000 gauss	£3 12 9
8″ H.F.810	10,000 gauss	£2 14 3
T359 tweeter	9,000 gauss	£1 10 6
T816	16,000 gauss	£5 13 6
T12 tweeter	16,000 gauss	£13 4 6
T10 tweeter	14,000 gauss	£4 8 3

**These three speakers incorporate a universal impedance speech coil.*

CROSSOVER NETWORKS: CX3,000 £1.11.6
CX,1,500 £2.0.0 CX500 £1.7.3

WHITELEY ELECTRICAL RADIO COMPANY LTD.

MANSFIELD · NOTTS · Tel: Mansfield 1762/5

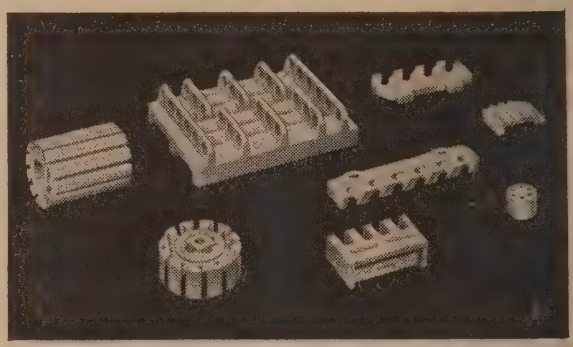
London Office: 109 Kingsway . W.C.2.

5WW—032 FOR FURTHER DETAILS.

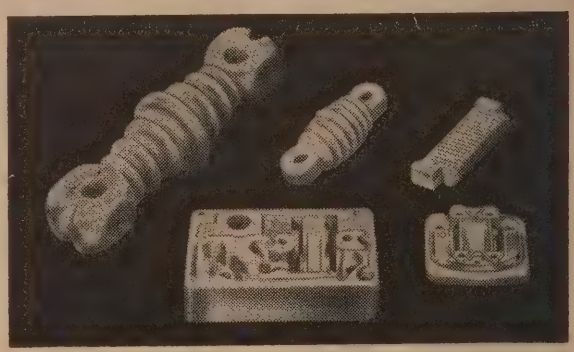
Bullers CERAMICS

for the **ELECTRONIC INDUSTRY**
(and Electrical Appliance Manufacture)

Frequelex—for high-frequency insulation.



Refractories for high-temperature insulation.



Bullers porcelain for general insulation purposes.

Meticulous care in manufacture, high quality material, with particular attention applied to *dimensional precision and accuracy,* explain the efficiency and ease of assembly when using Bullers die pressed products. *Write today for detailed particulars.*

BULLERS LIMITED

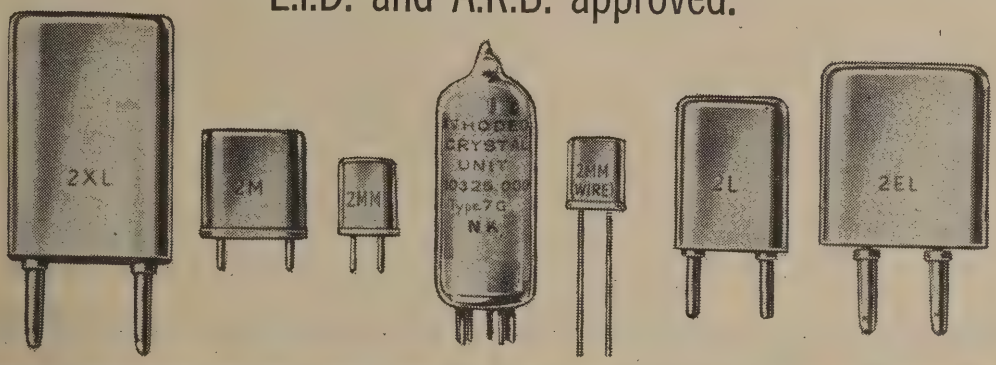
Milton, Stoke-on-Trent, Staffs.
Phone: Stoke-on-Trent 54321 (5 lines)
Telegrams & Cables: Bullers, Stoke-on-Trent
London Office: 6 Laurence Pountney Hill, E.C.4
Phone: MANsion House 9971

5WW—033 FOR FURTHER DETAILS.

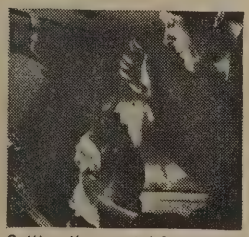
QUARTZ CRYSTAL UNITS FOR PRECISE SELECTION AND HIGH STABILITY CONTROL OF FREQUENCY

CATHODEON

Frequency Range 5 Kc/s to 100 Mc/s to meet DEF.5271, MIL. C.3098, N.A.T.O. and commercial specifications. E.I.D. and A.R.B. approved.

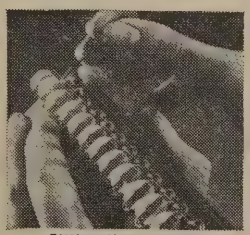


SPECIALISTS IN FREQUENCY CONTROL



Setting the crystal for cutting.

Mounting a finished crystal.



Fitting the contacts.

Comprehensive test equipment.

The benefits of the many years of development and manufacturing experience of Cathodeon specialists are readily available to all users of communications and other equipment involving precise selection and stabilisation of frequency, channel spacing, filter networks and the like. Cathodeon leadership in this field is reflected in the high quality and reliable performance of their products.

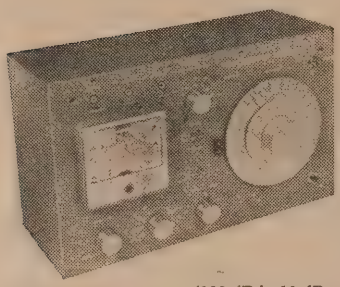
CATHODEON

CATHODEON CRYSTALS LIMITED · LINTON · CAMBRIDGE · TELEPHONE: LINTON 501 (4 lines)

5WW—034 FOR FURTHER DETAILS.

RADFORD

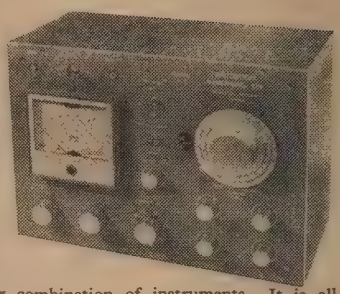
AUDIO LABORATORY INSTRUMENTS



LOW DISTORTION OSCILLATOR

Basically an instrument of high stability, providing very pure sine waves directly without the use of filters in the range 5 c/s to 250 Kc/s.
The instrument is valve operated for sine wave generation, but semiconductors are used in a sine/square network to provide clean square waves from 5 c/s to 250 Kc/s. An accurate step attenuator (100 dB in 10 dB steps) is incorporated together with a 0–10 dB continuously variable attenuator which may be directly monitored on the built-in valve millivoltmeter. The millivoltmeter is a 4-state feedback type with a very linear volt scale. It may be used for external measurement with a full scale deflection of 100 mV to 300 V. (8 ranges) with better than 0.5 dB accuracy over the range of the oscillator. The inherent distortion of the sine generator is lower than that of any other known instrument.

SPECIFICATION
Mains input: 110-140 v., 210-250 v., 50/60 c/s.
Output: 5 volts max. into 600 ohms.
Frequency range: Sine waves and square waves 5 c/s-250Kc/s.
Sine wave distortion: 0.006%, 200 c/s- 20 Kc/s.; increasing to 0.015% at 10 c/s. and 100 Kc/s.
Specification of included valve-millivoltmeter
Input resistance: 1 Megohm.
Sensitivity: 100 mV-300 V. f.s.d. (8 ranges).
Response: ±0.25 dB, 5 c/s-1 Mc/s.
Price: £95.



DISTORTION MEASURING SET

An instrument capable of measuring total harmonic distortion speedily, accurately, and directly on a calibrated meter scale without calculations or the use of ancillary balancing or rejection circuits. It is capable of reading a lower distortion level than any other known instrument or combination of instruments. It is all semiconductor operated, and is energised from an included 9 v. battery.

SPECIFICATION
Frequency range: 20 c/s–20 Kc/s (6 ranges).
Distortion range: 0.01%-100% f.s.d. (9 ranges).
Sensitivity: 100 mV-100 V. (0.01% and 0.03% f.s.d. ranges operate above 1 volt inputs).
Meter: Square law r.m.s. reading.
Input resistance: 200K ohms.
High pass filter 3 dB down at 500 c/s; 30 dB down at 50 c/s.
Harmonic response: ±1 dB 2nd harmonic to 250 Kc/s.
Price: £75.

RADFORD ELECTRONICS LTD. Ashton Vale Estate · Bristol, 3, England. *Tel:* 662301-2.

5WW—035 FOR FURTHER DETAILS.

FREE TO AMBITIOUS ENGINEERS — THE LATEST EDITION OF ENGINEERING OPPORTUNITIES

Have you sent for your copy?

ENGINEERING OPPORTUNITIES is a highly informative 156-page guide to the best paid engineering posts. It tells you how you can quickly prepare at home for a recognised engineering qualification and outlines a wonderful range of modern Home Study Courses in all branches of Engineering. This unique book also gives full details of the Practical Radio & Electronics Courses, administered by our Specialist Electronics Training Division—the *B.I.E.T. School of Electronics*, explains the benefits of our Employment Dept. and shows you how to qualify for five years promotion in one year.

We definitely Guarantee
"NO PASS—NO FEE"

Whatever your age or experience, you cannot afford to miss reading this famous book. If you are earning less than £25. a week, send for your copy of "ENGINEERING OPPORTUNITIES" today—FREE.

WHICH IS YOUR PET SUBJECT?

Mechanical Eng., Electrical Eng., Civil Engineering, Radio Engineering, Automobile Eng., Aeronautical Eng., Production Eng., Building, Plastics, Draughtsmanship, Television, etc.

GET SOME LETTERS AFTER YOUR NAME!

A.M.I.Mech.E.
A.M.I.C.E.
A.M.I.Prod.E.
A.M.I.M.I.
A.I.O.B.
B.Sc.
A.M.Brit.I.R.E.
City & Guilds
Gen. Cert. of Education
Etc., etc.

PRACTICAL EQUIPMENT

Basic Practical and Theoretic Courses for beginners in Radio, T.V., Electronics, Etc., A.M.Brit.I.R.E. City & Guilds Radio Amateurs' Exam. R.T.E.B. Certificate P.M.G. Certificate Practical Radio Radio & Television Servicing Practical Electronics Electronics Engineering Automation

INCLUDING TOOLS!

The specialist Electronics Division of B.I.E.T. NOW offers you a real laboratory training at home with practical equipment. Ask for details.

B.I.E.T. SCHOOL OF ELECTRONICS

POST COUPON NOW!

Please send me your FREE 156-page "ENGINEERING OPPORTUNITIES"
(Write if you prefer not to cut page)

NAME .....

ADDRESS .....

.....

.....

SUBJECT OR EXAM THAT INTERESTS ME .....

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY
(Dept. SE/22), 29 Wright's Lane, London, W.8

THE B.I.E.T IS THE LEADING ORGANISATION OF ITS KIND IN THE WORLD

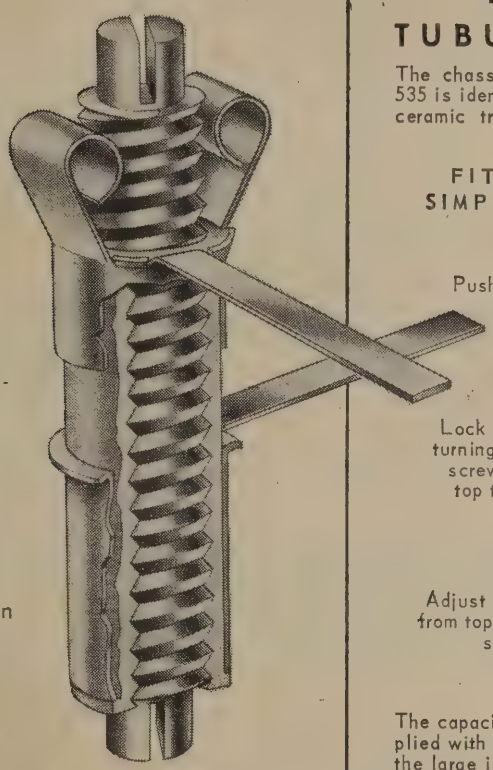
5WW—036 FOR FURTHER DETAILS.

REAL MINIATURIZATION...

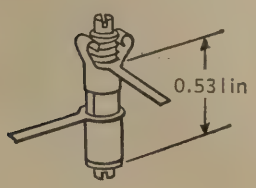
PLUS LOW LOSS FOR UHF...

ERIE STYLE 535 TUBULAR TRIMMER

The chassis punch-out required for the Style 535 is identical to that required for the tubular ceramic trimmers that are in general usage.

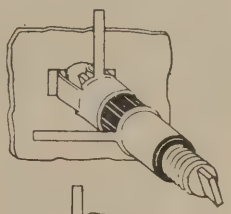


STYLE 535 TUBULAR TRIMMER (PATENTED) ILLUSTRATED ACTUAL SIZE

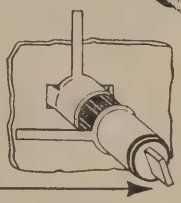


FIT THIS SIMPLE WAY

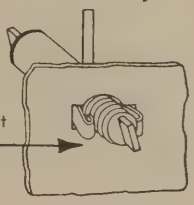
1 Push in hole



2 Lock in hole by turning adjusting screw through top terminal



3 Adjust capacitance from top at final test station



The capacitance adjusting plunger can be supplied with either the screwdriver slot shown in the large illustration, or with a milled flat end illustrated above.

The simplicity of design of the Style 535 trimmer results in very low inductance and uniform, linear, noiseless adjustment: the ribbon-type leads help to minimise inductance in UHF circuits. When mounted, the high-temperature polystyrene body extends only 0.531in from the underside of the chassis and is only 0.218in in diameter.

The Style 535 Tubular Trimmer combines the desirable features of small size, easy mounting, stable performance and economical price. Capacitance range is from 0.7 to 3pF and working voltage is 500 d.c. Variations in terminal orientation and hardware can be provided on request, according to demand.

Write for 535 literature

ERIE ELECTRONIC COMPONENTS

*Registered Trade Mark

ERIE RESISTOR LIMITED GREAT YARMOUTH NORFOLK Telephone 4911 Telex 1720

5WW—037 FOR FURTHER DETAILS.

NEW FANE 12" HEAVY DUTY LOUDSPEAKER MODEL 122/10

2" VOICE COIL — 10,000 GAUSS — 20 WATTS R.M.S.

RETAIL PRICE **5 gns.**

This latest addition to the FANE range of heavy duty loudspeakers permits Hi-Fi on the slenderest budget.

Standard input impedance is 15 ohms but, like all FANE heavy duty speakers, these units can be supplied with special bi-filar wound voice coils, if requested, giving a 4 ohm input impedance without the usual loss in efficiency.

The Model 122/10 is normally built with a main resonance of 40 c.p.s. for general use as a bass reproducer. All FANE 12in. units can be supplied with a cone giving a resonance of 70 c.p.s. for use with electric lead or rhythm guitars for which is it very suitable. Please state which resonance is required when ordering. It should be noted that Fane Heavy Duty loudspeakers have pole pieces of larger diameter than is usual. This results in a substantial increase in total flux with a proportionate increase in efficiency. When compared with speakers of same Flux Density but with the usual diameter pole pieces due allowance should be made for this.

Manufacturers enquiries direct to

FANE ACOUSTICS LIMITED

HICK LANE — BATLEY — YORKSHIRE

If in difficulty customers other than trade may purchase direct from us by post where at present there is no local stockist.

Sole distributors to the wholesale & retail trade:—

LINEAR PRODUCTS LTD.—ELECTRON WORKS—ARMLEY—LEEDS 12

5WW—038 FOR FURTHER DETAILS.

A NEW RANGE OF TUNERS by... Armstrong

224 FM TUNER

Self powered with full provision, including space on the chassis, for simply plugging in an Armstrong Stereo Multiplex Decoder when regular stereo transmissions begin. Featuring precision tuning meter, dual audio outputs with pre-set gain control on each, and exceptional sensitivity. The styling is similar to the 223 Tuner as illustrated.

Price **£22.10.0**

SPECIFICATION

Coverage	87—108 M/cs.
Sensitivity	1·5 μV for 20 db quieting.
Output	0—2 volts variable to match any amplifier or tape recorder.
Stages	R.F. Stage, Two IF Amplifiers, Limiter Stage and Foster Seeley Discriminator.

223 AM-FM TUNER *(illustrated)*

Identical in performance to the 224 above but with the addition of the Medium waveband.

Price **£28.15.0**

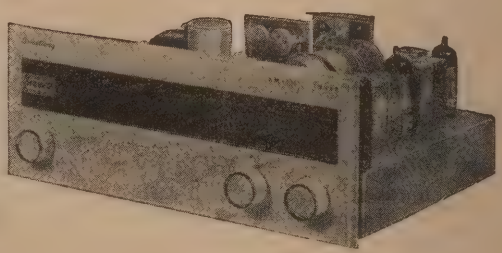
SPECIFICATION

FM Band as the 224 above.

AM Band

Coverage	180—600 metres.
Sensitivity	5μV for 20 db quieting.
Automatic Variable Selectivity	2 to 8 K/cs. depending on signal strength.
Filter	Built in Heterodyne rejection filter.

The new 224 FM Tuner and 223 AM-FM Tuner are designed to provide outstanding facilities and performance with any tape recorder or amplifier.



Optional cases of teak and vinyl-hide are available for all models.

222 STEREO-AMPLIFIER—a new Integrated Stereo Amplifier matched in styling and performance to the NEW Armstrong Tuners.

Price **£27.10.0**

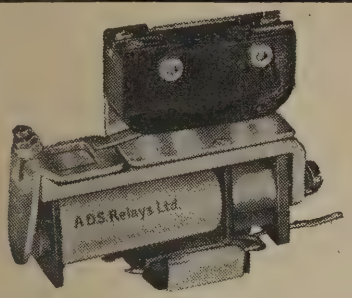
Full descriptive literature available from Dept. No. WFT

ARMSTRONG AUDIO LTD. Warlters Road, London, N.7. Telephone: NORth 3213

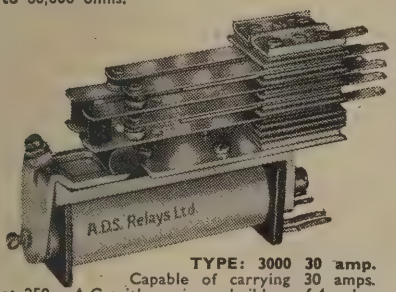
5WW—039 FOR FURTHER DETAILS.

3000 TYPE RELAYS

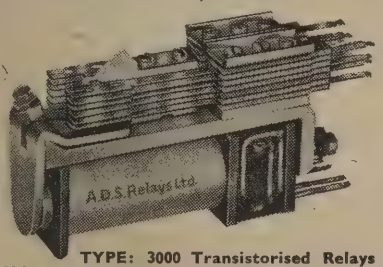
A.I.D. A.R.B ADMIRALTY APPROVED



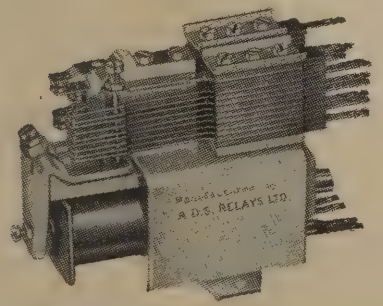
TYPE: 3000 MICRO SWITCH
Can be fitted with any type of micro switch; light and heavy duty contact sets as required. Coil: 2 to 80,000 ohms.



TYPE: 3000 30 amp.
Capable of carrying 30 amps. at 250 v. A.C. with maximum build up of 4 makes or 4 breaks. Coil: .1 to 80,000 ohms.

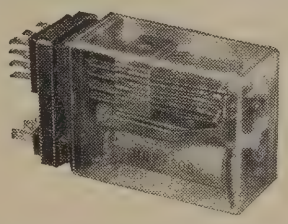


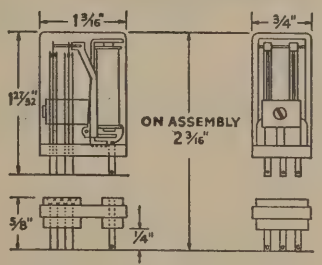
TYPE: 3000 Transistorised Relays
T.1 Operates from 300 to 500 micro/amps. at 1½ volts D.C.
T.2 Operates from 3 to 5 micro/amps. at 1½ volts D.C. Maximum contacts 2 change overs light duty or 2 change overs heavy duty.
T.3 Operates from 15 to 30 micro/amps. at 1½ volts D.C. Maximum contacts six change overs light duty.
T.1, T.2, T.3. Energised 12 to 18 volts D.C.



TYPE: 3000 B.O.3.
With its own bracket for fitting in any position, so designed to interlock with each other. Coil .1 to 80,000 ohms.

MINIATURE PLUG-IN RELAYS



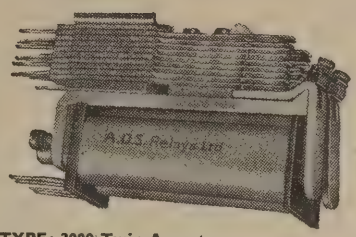


Operate D.C. Volts		Type
6 Volts	68.5 mA.	(MQP 108)
12 Volts	37.0 mA.	(MQP 208)
24 Volts	19.5 mA.	(MQP 308)
48 Volts	10.2 mA.	(MQP 408)
100 Volts	4.9 mA.	(MQP 508)

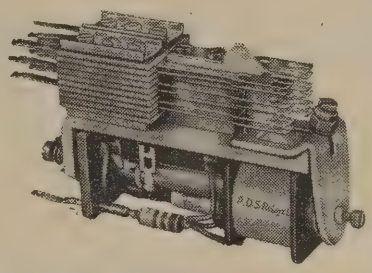
Fitted 4 C at 1 amp.—
100 V.D.C.
Operate Time 6 m/S.
Release Time 4 m/S.
Insulation up to 250 V.A.C.
Twin Contacts.
Temperature: — 10° c to + 40°c.
Mounting: only requires 2 screws.
Fitting supplied with Relay.
Mounting Rack can be supplied for 36 Relays.
P.O. 19in. x 3½in.
These Racks can be cut to any size.
Weight of Relay 43 grams.

Quantity up to 10 at 16/- each.

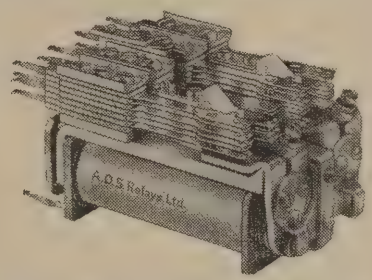
Further discount according to quantity.



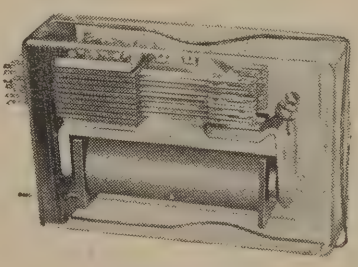
TYPE: 3000 Twin-Armature
This relay is a space saver! Two relays in one. Two coils, two armatures, working independently. Contacts maximum 4 change overs light duty or 2 change overs heavy duty. Coils: Maximum 10,000 ohms.



TYPE: 3000 Delay Relay
This relay can be supplied with operate/delay up to 25 seconds from supply of 6 to 50 volts D.C. Release delay up to 25 seconds with trigger circuits to 1½ volts D.C. Energised from 6 to 50 volts D.C. Contacts maximum 6 change overs light duty.
With adjustable resistor giving plus or minus 2 seconds of nominal figure on operate and release relays.



TYPE: 3000 Mechanical Latching Relays
Built to customer's requirements.
Coils: .1 to 80,000 ohms.



3000 TYPE P.I.
Plug-in Relay

A.D.S. RELAYS LTD

89-97, ST. JOHN STREET, CLERKENWELL, E.C.1

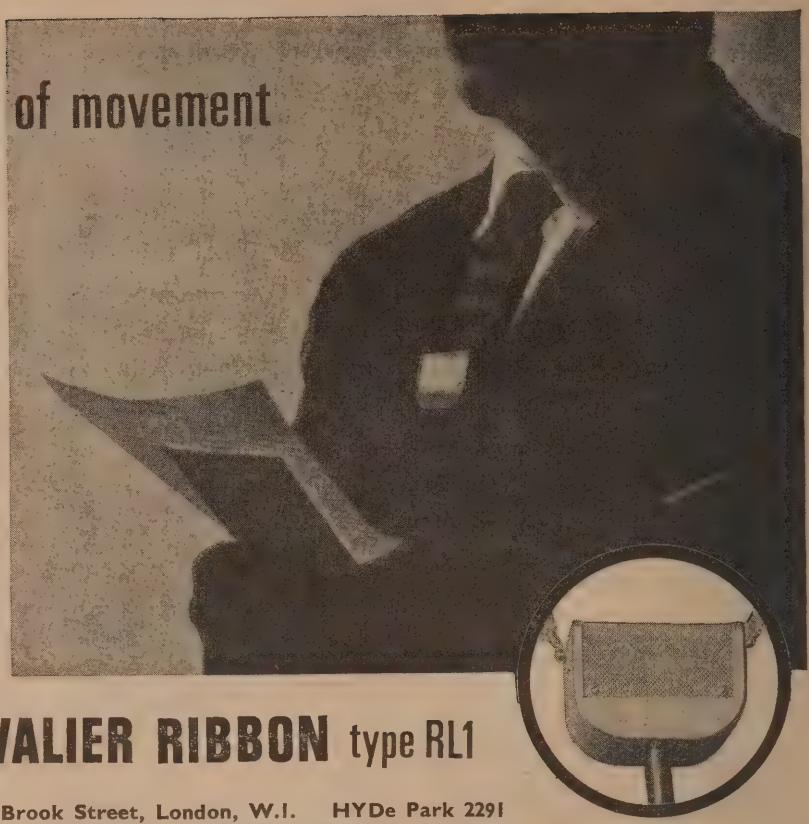
Telephone: CLErkenwell 3393/4/5

5WW—040 FOR FURTHER DETAILS.

complete freedom of movement

The Reslo ribbon Lavalier is a miniature high quality light-weight unit, designed for suspension from the user's neck by means of an adjustable cord. The frequency response is smooth, wide and similar to the PR type but the field of sound pick-up s arranged to be largely from the top of the microphone to give a very natural quality reproduction of the user's voice.

The microphone is available in three impedances and is complete with plug and socket connector and long length of twisted and screened cable for connecting to the associated equipment.



DERRITRON GROUP Reslo **LAVALIER RIBBON** type RL1

RESLOSOUND LTD., 24 Upper Brook Street, London, W.1. HYDe Park 2291

5WW—041 FOR FURTHER DETAILS.

THE TECHNIQUE OF SOUND REPRODUCTION

Edited by John Borwick, B.Sc.

RADIO RECEPTION

by H. Henderson, B.Sc., A.Inst.P., A.M.I.E.E.
256 pages. 211 diagrams

Basic A.C. and D.C. Valve Theory. Transistor Theory. General Principles of Reception. The Radio Frequency Stage. Frequency Changing. The Intermediate Frequency Amplifier. Circuits: Alignment and Performance. Receiving Aerials. Transmission and Reception of Stereo Sound.

LOUDSPEAKERS

by E. J. Jordan, A.M.Brit.I.R.E.
228 pages. 123 diagrams

Radiation of Sound. The Motor System, Cones and Suspensions. Criteria. Single Cone Wide Range L/S. Multiple Radiating Systems. Double Cone Single Coil L/S. Electrical Dividing Networks. L/S for Specific Bands. Enclosures. The Full Range Electrostatic L/S. General Purpose Systems. Stereo Reproduction. Environment. Radiation and Analogy Calculations.

TAPE RECORDING AND REPRODUCTION

by A. A. McWilliams, Grad.I.E.E.
288 pages. 170 diagrams

Sound and Sound Reproduction. Recording Machines. Principles of Magnetism. Recording Tapes. Recording and Replay Process. Equalization. Transport System. Electronic Equipment. Machine Use, Testing, Maintenance. Jointing and Editing. Special Applications.

Also by John Borwick.

SOUND FACTS AND FIGURES

No other book gives all the facts so concisely. You can find the meanings of words at a glance; all you need to know. 176 pages. 183 diagrams. 12/6.

DISC RECORDING AND REPRODUCTION

by P. J. Guy, A.M.I.E.E. 256 pages. 151 diagrams

History. Theory. How a Disc Recording is Made. Reproducing Systems. Stereophonic Recording and Reproduction. Screening. Hum, Wow, etc. Volume Controls. Measuring Response. Equalizers, Copying to Tape. How to Choose a Record Player.

AMPLIFIERS

by H Lewis York. 256 pages. 180 diagrams

Introduction to Electronics. Voltage Amplification. Graphical Analysis. Tetrodes and Pentodes. Power Amplifiers. Negative Feedback. Phase Splitting. Supply Units. Design for 3, 10 and 30 watt Amplifiers. Testing. Low Voltage Sources. Frequency Correction and Tone Control. Transistors. Stereophony.

ACOUSTICS

by G. W. Mackenzie, A.M.Brit.I.R.E.
256 pages. 135 diagrams

How Sound Sources Work and Sound Waves Travel. The Mechanism of Hearing, Speech and Musical Instruments. Room Acoustics. Microphones, How They Work and How to Use Them.

Price 42/- per volume

FOCAL PRESS, 31 Fitzroy Square, London, W.1

5WW—042 FOR FURTHER DETAILS.

Do you face the universal problem? Does your labour become more expensive every year? Is labour the biggest single factor in your production costs?

Then you should visit

mechanical handling exhibition

EARLS COURT · LONDON · 5–15 MAY

See the world's largest display of time, cost and labour saving equipment

Today mechanisation is the only answer to spiralling costs and increasing competition. At the Mechanical Handling Exhibition you can see — under one roof — the world's latest and most efficient equipment for saving labour, reducing costs, increasing output. Industrial tractors, conveyors, hand and fork-lift trucks . . . cranes, elevators, hoists, winches . . . aerial ropeways, bulk handling plant, earth-moving equipment — plus ancillary equipment ranging from electronic control devices to castors and tyres. Everywhere there are working exhibits.

Much of the equipment is designed for operations common to many industries; you can also see equipment which can be adapted to the most unusual and difficult manufacturing processes.

This is a unique opportunity to inspect the last word in every form of industrial mechanisation, at the largest exhibition of its kind in the world. The enquiry form below will bring a brochure and season ticket.

Sponsored by the ILIFFE *journals* MECHANICAL HANDLING *and* MATERIALS HANDLING NEWS *with the support of the leading trade associations*

Admission by ticket— free from organizers

SEND THIS ENQUIRY NOW

To: The Organizers, Mechanical Handling Exhibition, Dorset House, Stamford Street, London, S.E.1.

Please forward brochure and free season ticket

NAME .....

FIRM .....

ADDRESS .....

.....

41

5WW—043 FOR FURTHER DETAILS.

CHASSIS and CASES

by Smith's of EDGWARE ROAD

ELECTRONIC COMPONENT DISTRIBUTORS

287/289 EDGWARE ROAD, LONDON, W.2.
Tel: PADdington 5891/7595

We shall be pleased to quote for all your component requirements

BLANK CHASSIS

SAME DAY SERVICE

Of over 20 different forms made up to **YOUR SIZE.** Order EXACT SIZE you require to nearest $\frac{1}{16}$th.
(Maximum length 35in., depth 4in.)
Specials dealt with promptly.

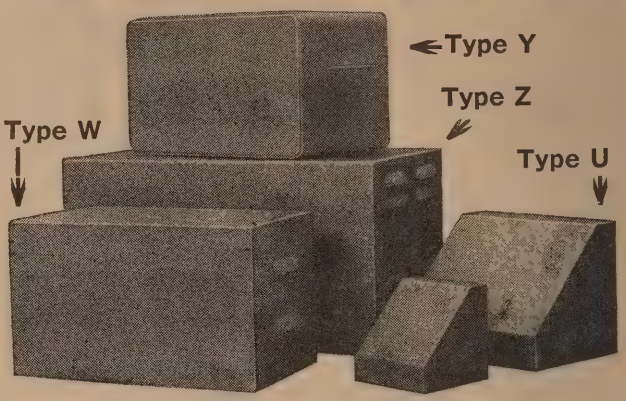
SEND FOR ILLUSTRATED LEAFLETS

or order straight away, working out total area of material required and referring to table below which is for four-sided chassis in 18 s.w.g. (for 16 s.w.g. add $\frac{1}{16}$th).

48 sq. in.	4/–	176 sq. in.	8/–	304 sq. in.	12/–
80 sq. in.	5/–	208 sq. in.	9/–	336 sq. in.	13/–
112 sq. in.	6/–	240 sq. in.	10/–	368 sq. in.	14/–
144 sq. in.	7/–	272 sq. in.	11/–	and pro rata.	
P. & P. 2/6		P. & P. 2/9		P. & P. 3/-.	

Discounts for quantities. Finishes arranged for quantities of 25 or over.

FLANGES ($\frac{1}{4}$in., $\frac{3}{8}$in.), **6d** per bend.
STRENGTHENED CORNERS 1/- each corner.
PANELS: Any size up to 3ft. at 4/6 sq. ft. 18 s.w.g.; (16 s.w.g. 5/3). Plus post and packing, over £2 free.



CASES

ALUMINIUM, SILVER HAMMERED FINISH

Type	Size	Price	Type	Size	Price
U	4 x 4 x 4*	9/6	Y	8 x 6 x 6*	25/–
U	5½ x 4½ x 4½	14/6	Y	12 x 7 x 7	39/–
U	8 x 6 x 6	20/–	Y	13 x 7 x 9	44/–
U	15 x 9 x 9	42/6	Y	15 x 9 x 7	46/–
W	8 x 6 x 6	19/6	Z	17 x 10 x 9	63/–
W	12 x 7 x 7	32/6	Z	19 x 10 x 8½	67/6
W	15 x 9 x 8	42/–	*Height.		

Plus post and packing (over £2 free).

Type U has removable bottom or back, Type W removable front, Type Y all-screwed construction, Type Z removable back and front.

5WW—044 FOR FURTHER DETAILS.

THE SOUND OF QUALITY

LUSTRAPHONE

the foremost name in microphones

Modern sound techniques need to be matched by microphones of quality—Lustraphone microphones. There is a wide range of ribbon and dynamic models to meet every requirement. Models range from general purpose microphones for tape recorders to studio stereo assemblies. Entirely British made, all Lustraphone products are manufactured to the most advanced designs and the most exacting standards.

Send for fully illustrated literature

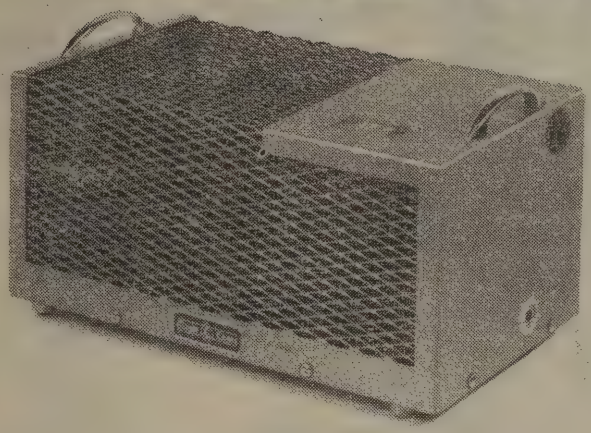
LUSTRAPHONE LIMITED

(Dept. W.W.3.) St. George's Works, Regent's Park Road, London, N.W.1., England.

Telephone: PRImrose 8844/5/6 Grams: Lustraphon, Norwest, London Cables: Lustraphon, London

5WW—045 FOR FURTHER DETAILS.

this stabiliser is news!



Claude Lyons new BTR solid-state voltage stabiliser

high accuracy | low distortion | high reliability | high-speed response | low price

The new type BTR represents a major advance in **a.c.** voltage stabiliser design.

The proven transductor regulating circuit is employed in an entirely new configuration (patent pending) giving remarkably low harmonic distortion *without filtering*, together with the high output stability of ±0.3%. The output is unaffected by frequency variations from 45 to 65 c/s and load variations from zero to full load.

The design features solid-state circuitry and a printed circuit plug-in control amplifier which, together with the absence of valves, relays or moving parts, provide extremely high reliability.

Three models are available, rated at 2, 5 and 13 amperes. The operating voltage can be set at any value from 200 to 254 volts, and three alternative input ranges are provided.

In addition, for particularly critical applications, filtered models are available, in which, at the filter frequency, the distortion is reduced to a truly negligible level, and the stability further improved to ±0.2%.

The BTR range offers high accuracy, rapid response, very low distortion, rugged reliability and—due to the simple and efficient design—at prices unusually low for this class of instrument.

BASIC MODELS				
Type	Rating	Accuracy	Distortion	Price £ s.
BTR-2	480 VA	±0·3%	<6%	49 10
BTR-5	1200 VA	±0·3%	<6%	67 10
BTR-13	3100 VA	±0·3%	<7%	105 0
FILTERED MODELS				
BTR-2F	480 VA	±0·2%	<2%	58 10
BTR-5F	1200 VA	±0·2%	<2%	83 10
BTR-13F	3100 VA	±0·2%	<2·5%	133 0

115 volt models are also available

Our complete range of stabilisers includes models with ratings up to 120kVA single phase, 360kVA three phase.
Write for full information to
Publicity Department, Hoddesdon.

Claude Lyons

CLAUDE LYONS LTD

Valley Works, Hoddesdon, Herts. *Hoddesdon 4541. Telex 22724*
76 Old Hall Street, Liverpool, 3. *MARitime 1761. Telex 62181*

5WW—046 FOR FURTHER DETAILS.

CL35 B

EVERY FEATURE YOU COULD WANT IN THIS POCKET MULTIRANGE TEST SET NOW REDUCED TO £7·17·6

TRADE PRICE

- D.C. SENSITIVITY 20,000 ohms per volt.
- A.C. SENSITIVITY 2,000 ohms per volt.
- A.C. ACCURACY maintained up to 20 kc/s.
- TWENTY RANGES.
- ADDITIONAL DECIBEL SCALE.
- PRESSED STEEL CASE.

minitest

WITH LEATHER CASE £8·12·6

A modern self-contained multirange test set of high sensitivity, intended for the measurement of A.C. and D.C. volts, D.C. current and resistance.

The pressed steel case not only effectively screens the movement from external magnetic fields but also provides that **extra** protection against the accidental blow or mishandling that would fracture a completely plastic moulding.

The exterior cover is moulded in grey Melamine and is designed to focus attention on the clear easy-to-read scale.

IMMEDIATE DELIVERY

SALFORD ELECTRICAL INSTRUMENTS LTD

PEEL WORKS SILK STREET SALFORD 3 LANCS.
Tel: Blackfriars 6688
London Sales Office: BROOK GREEN, HAMMERSMITH, W.6. Tel: Riverside 5246
A Subsidiary of THE GENERAL ELECTRIC CO. LTD. OF ENGLAND

SEI

5WW—047 FOR FURTHER DETAILS.

TECHNICALLY TRAINED by ICS IN RADIO, TELEVISION AND ELECTRONIC ENGINEERING

Opportunities in Radio Engineering and allied professions await the I C S trained man. I C S Courses open a new world to the keen student.

RADIO AND TELEVISION ENGINEERING:
RADIO AND TV SERVICING:
ELECTRONICS, COMPUTERS & DATA PROCESSING, etc.

I C S Courses give very real help to the man setting up his own business of facing a technical career in the radio industry. Examination Courses for:—British Institution of Radio Engineers, City & Guilds TELECOMMUNICATION TECHNICIANS, C. & G. Radio & TV Servicing (R.T.E.B.), and P.M.G. Certificates in Radio Telegraphy, C. & G. Radio Amateurs.

NEW PRACTICAL-RADIO COURSES
Build *your own* 5-valve superhet radio receiver, Signal Generator High quality Multitester and Portable Transistor.

FILL IN AND POST THIS I C S COUPON TODAY
It brings the FREE I C S Prospectus containing full particulars of I C S Courses in Radio, Television and Electronics.

MEMBER OF THE ASSOCIATION OF BRITISH CORRESPONDENCE COLLEGES.

INTERNATIONAL CORRESPONDENCE SCHOOLS

...A WHOLE WORLD of KNOWLEDGE for the KEEN STUDENT

International Correspondence Schools (Dept. 222), Intertext House, Parkgate Road, London, S.W.11.

NAME.....

ADDRESS .....
Block Capitals Please

.....

.....2.64

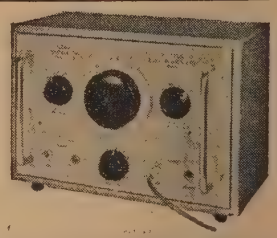
5WW—048 FOR FURTHER DETAILS.

WINSTON INSTRUMENTS

DECADE RESISTOR BOXES
Range: 100 ohms to 111,000 ohms. Zero Resistance: 0.006 ohms. Accuracy: ±1%. Maximum current: 10's decade 100mA. 100's decade 35mA. 1,000's decade 10mA. Terminals: Screw Type. Dimensions (overall): Height 3in. (7.5 cms.). Width 8in. (20 cms.). Depth 3¾in. (9.5 cms.). Weight 5 lb. (2.3 Kgs.). **£13.13.0**

SEMI-DECADE OSCILLATOR

Frequency range: 10 C.S. to 100 Kc/s. Calibration accuracy 1% Output: sine wave variable from 0-10 v. peak. Total content of harmonics and hum is less than 1%. Square wave of fixed amplitude of 10 v. ±5% maximum drop at 10 cps. is 2%. This rise and fall time at 100 Kc/s. is 1 Micro. sec. **£39.10.0.**



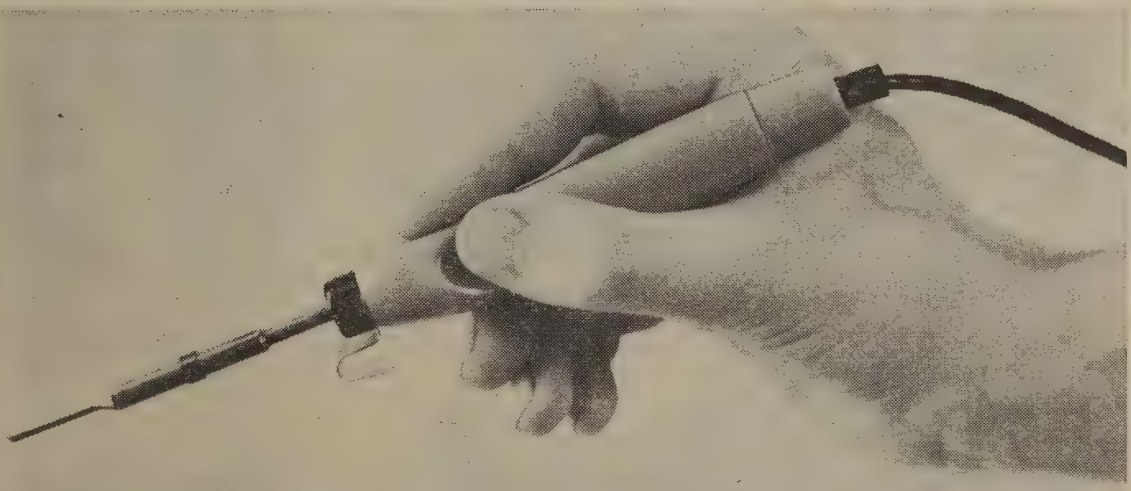
DECADE CAPACITOR BOXES
Range: .001 mfd. to 1.11 mfd. Zero Capacitance: 50 pf. Accuracy: ±5%. Maximum Voltage 750 v. D.C. Terminals: Screw Type. Dimensions: (overall): Height 3ins. (7.5 cms.). Width 8in. (20 cms.). Depth 3¾in. (9.5 cms.). Weight 5lb. (2.3 Kgs.). **£11.11.0**

WINSTON ELECTRONICS LIMITED

Write for full particulars to Dept. W.W.
GOVETT AVE., SHEPPERTON, MIDDX.
Telephone: Walton-on-Thames 26321/8
Telegrams: WINSTON SHEPPERTON

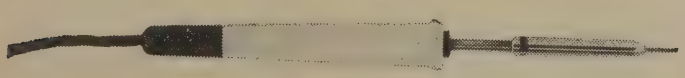
5WW—049 FOR FURTHER DETAILS.

Ain't write [ONLY AN ILLITERATE WOULD HOLD A PEN LIKE A SOLDERING IRON]



RIGHT [YOU HOLD A PRECISION IRON LIKE A PEN FOR A NEW GRIP ON SOLDERING ACCURACY]

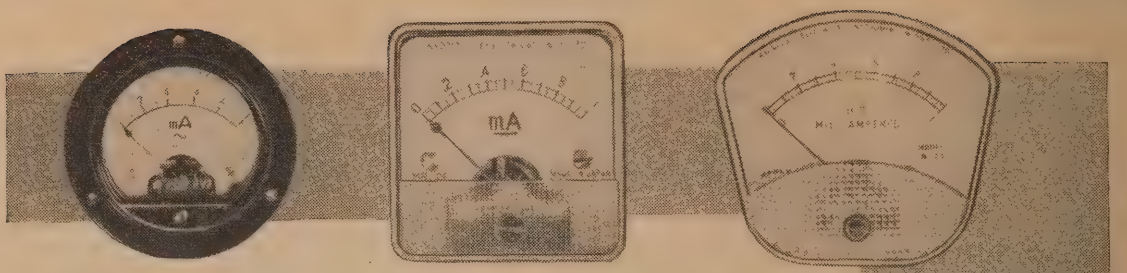
A Precision iron, with its sculpted, balanced handle, makes joints as neatly and accurately as dotting an 'i' or crossing a 't'. On the production line, the Precision method means reduced operator fatigue, increased speed and efficiency. **Fast heat-up.** Here's another performance-plus: the heating element of a Precision iron extends right up into the high conductivity bit for double-quick heating on half the power. No less than 39 bits are available with a choice of 3 bit shapes in most sizes. For more specific information or advice write:



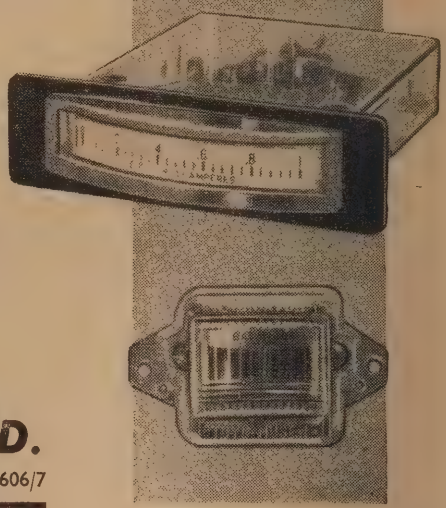
A·N·T·E·X

ANTEX LIMITED | GROSVENOR HOUSE | CROYDON | SURREY | MUNICIPAL 2774

5WW—050 FOR FURTHER DETAILS.



panel measuring instruments



. . . the most advanced and comprehensive range of electronic measuring instruments, manufactured by Kyoritsu Electrical Instruments Ltd., of Japan, famous the world over for the quality, accuracy and precision of their Panel Meters. The comprehensive range covers over 1,000 basic movements in over 40 designs each in a variety of sizes and colours. Special features include a range of bakelite cases, clear plastic cases, edgewise and expanded scale instruments.

Whatever your specific requirements . . . . . in panel meters . . . . . you'll find a "Kew" instrument that meets your needs precisely.

For catalogue and further details write to Sole U.K. Distributors:

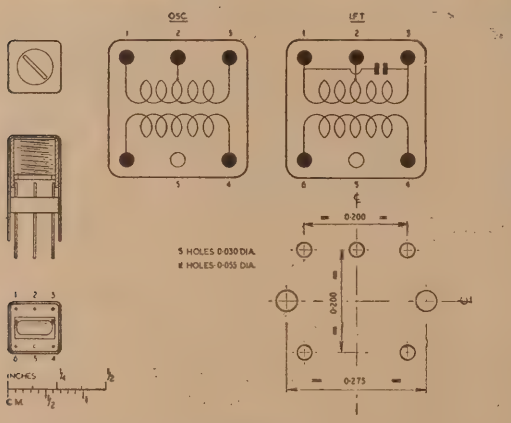
B. ADLER & SONS (RADIO) LTD.

Instrument Division, 32a, Coptic Street, London, WC1 Telephone: MUSeum 9606/7

5WW—051 FOR FURTHER DETAILS.

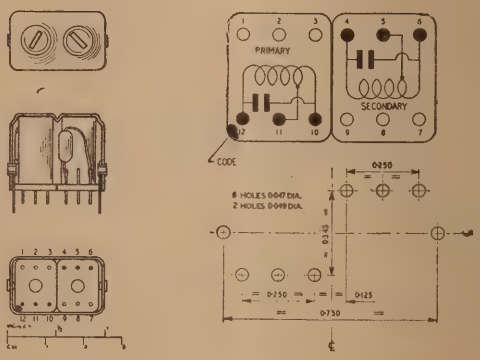
TWO NEW TYPES OF "WEYRAD" I.F. TRANSFORMERS FOR SET-MAKERS

MAXIMUM PERFORMANCE—MINIMUM SIZE—COMPETITIVE PRICE



TYPE P10

Oscillator Coils and Single-tuned I.F. Transformers
7 x 7 x 11 mm.
Osc. Coils cover medium wave with 85 pF capacity swing.
I.F.s for 470 Kc/s operation.



TYPE T80

Double-tuned 1st and 2nd I.F. Transformers
21 x 13 x 18 mm.
T81 1st I.F. "Q" 85.
T82 2nd I.F. "Q" 100.
Coupling for each type—critical.

Versions for most types of Transistors are in production.

Samples and prices available to bona fide manufacturers on request.

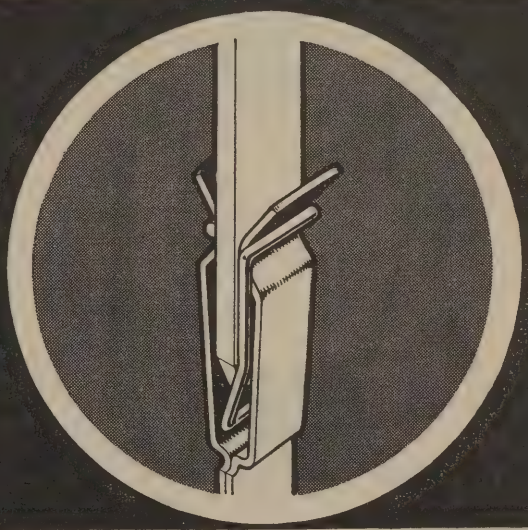
WEYMOUTH RADIO MANUFACTURING CO., LTD.

REGENT FACTORY, SCHOOL STREET, WEYMOUTH, DORSET

5WW—052 FOR FURTHER DETAILS.

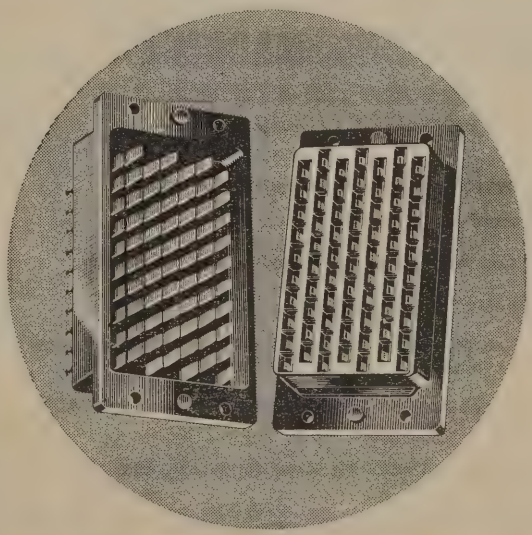
unique contacts ensure good connections with

FERRANTI LOW FORCE CONNECTORS



35, 70, 91 POLE SIZES

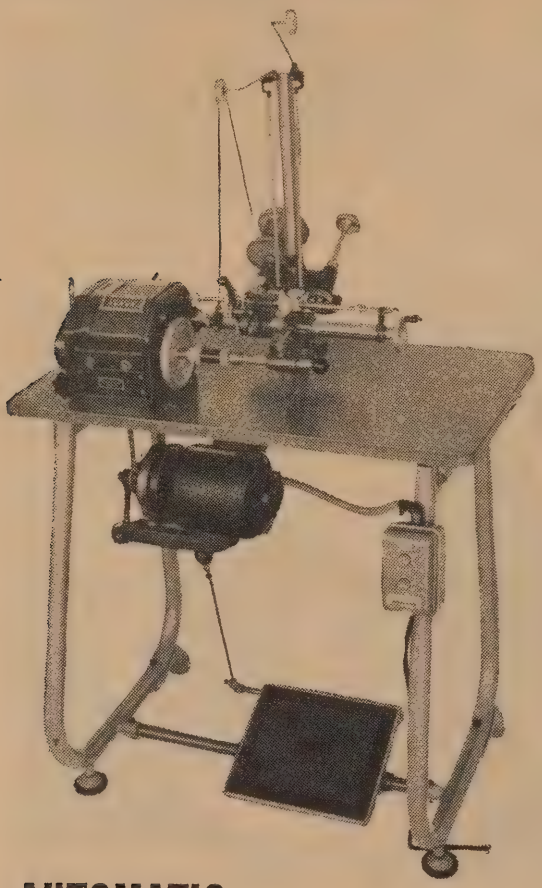
- VERY LOW INSERTION FORCE
- LOW RATE FLOATING SPRING
- CONTROLLED CONTACT PRESSURE
- UNSURPASSED RELIABILITY



Full details available from : **FERRANTI LTD. KINGS CROSS ROAD, DUNDEE.** *Telephone:* DUNDEE 87141

WW—053 FOR FURTHER DETAILS.

Kolectric present their



AUTOMATIC COIL WINDING MACHINE

Type A/I1 (25-50 S.W.G.)
Type A/IX (19-46 S.W.G.)

incorporating ALL these refinements:

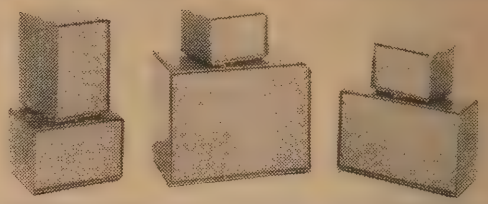
- ★ Dustproof construction
- ★ Provision for simultaneous winding of several coils
- ★ Micrometer traverse setting
- ★ Wire gauge indicator engraved with various settings to which machine can quickly be adjusted
- ★ Instantaneous re-set turns counter reading up to 100,000 turns
- ★ Efficient wire tensioning stand supporting two reels of wire
- ★ Cadmium- or chromium-plated steel parts

A fully illustrated leaflet quoting complete technical specifications is available. We will be pleased to send it to you on request.

KOLECTRIC LTD SINCLAIR HOUSE, THE AVENUE, EALING, LONDON W.13 Tel.: PERIVALE 9066

5WW—054 FOR FURTHER DETAILS.

NEW from OLSON



MODERN CASES FOR MODERN REQUIREMENTS

The firm of Olson Electronic Ltd. have found need for small instrument cases in the industry and are introducing a series of small cases designed to satisfy the demands of miniature assemblies, these are strongly made of 20 s.w.g. nilld steel and finished in silver-grey hammertone stove enamel with front panel in light grey (shade 631) high gloss enamel.
Rubber feet are fitted to all cases. Vent panels can be fitted at a small extra charge.

TYPE	WIDTH	HEIGHT	DEPTH	FRONT PANEL
25A	6½in.	4½in.	4½in.	18 swg
25B	6½in.	4½in.	6½in.	18 swg
26A	8½in.	5½in.	6½in.	18 swg
26B	8½in.	5½in.	8½in.	18 swg
27A	12½in.	7½in.	5½in.	16 swg
27B	12½in.	7½in.	8in.	16 swg
28A	14in.	10½in.	6½in.	16 swg
28B	14in.	10½in.	8½in.	16 swg

NEW SIZES OF INSTRUMENT CASES (STANDARD SIZES)

TYPE	WIDTH	HEIGHT	DEPTH	
29A	10in.	4in.	6in.	18 swg
29B	10in.	4in.	8in.	18 swg
30A	12in.	5in.	6in.	18 swg
30B	12in.	5in.	8in.	18 swg
31A	14in.	6in.	6in.	18 swg
31B	14in.	6in.	8in.	18 swg

STANDING CASES

40A	4½in.	6½in.	6in.	18 swg
40B	5½in.	8½in.	6in.	18 swg
40C	5½in.	8½in.	8in.	18 swg

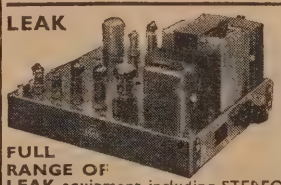
Quotations gladly given for customers' own specifications and special requirements

OLSON ELECTRONIC LIMITED, 54 Myddleton Street, LONDON, E.C.1 Telephone: TERminus 8031

5WW—055 FOR FURTHER DETAILS.

COMPREHENSIVE STOCK OF THE BEST IN HI-FI EQUIPMENT, SPEAKER ASSEMBLIES, F.M. TUNERS, etc.

LEAK

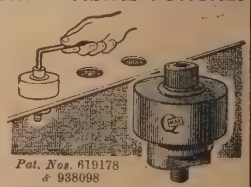


FULL RANGE OF LEAK equipment including STEREO 20 AMPLIFIER giving 2 x 11 watts power output. **£30/9/-.**

FM91. FM TUNER 87.5-100 Mc/s **£20/7/4** unpowered; **£23/16/7** powered. All other Chapman products in stock.

STOCKS OF RECOMMENDED TAPE RECORDERS—*Descriptive lists on application.*

"Q-MAX" SHEET METAL PUNCHES



Pat. Nos. 619178 & 938098

ROUND, SQUARE and RECTANGULAR

The easiest and quickest way of punching holes in SHEET METAL.

NEW SIZES:
⅜" 11/6 $\frac{7}{16}$" 12/3
(Key 10d)

List of Sizes and Prices on Application.

SOLE LONDON DISTRIBUTORS OF ELCOM MINIATURE MULTI-WAY PLUGS, SOCKETS, & COVERS

Price List on application.

ILLUSTRATED CATALOGUE 6d Post Free.

BERRY'S RADIO 25 HIGH HOLBORN, LONDON, W.C.1. Telephone: HOLborn 6231/2.

5WW 056 FOR FURTHER DETAILS.

*The experts agree...

on the NEW

C1 Ceramic Cartridge

by BSR

Flip-over stylus
High fidelity sound
A popular price

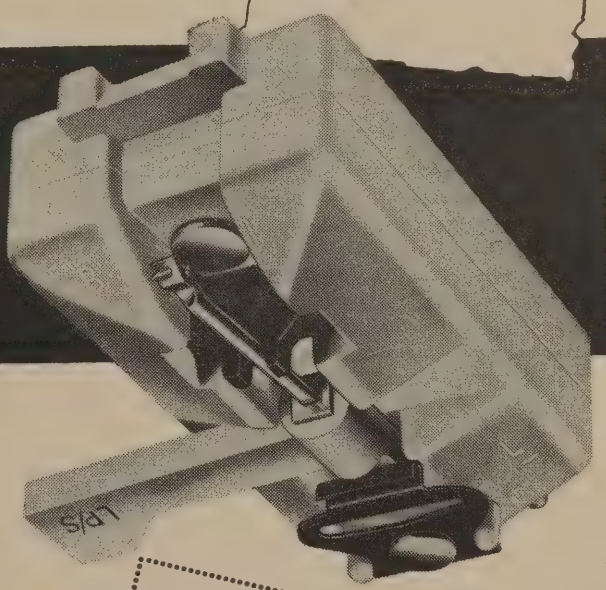
*Donald Aldous
of Audio & Record Review

"... an excellent design of ceramic cartridge. It sounds good and the waveform as seen on the oscilloscope was clean at all tested frequencies. Knowing how inconsistent the performance of crystal and ceramic pick-ups can be we tested two samples. Results matched quite closely. We are sure that a lot of equipment manufacturers will be fitting this cartridge."

*Geoffrey Horn
of The Gramophone

"... It is nice to be able to report that quality is not forgotten ... one must straightaway concede that to produce a cartridge of this calibre is to plant another milestone on the public right of way to high fidelity.

Fits all arms with centre hole or standard ½" fixing centre.



This new ceramic cartridge from BSR gives you all these wonderful 'enthusiast' features—78's and L.P's. mono or stereo ... high compliance of 5.2 x 10^{-6} cm/dyne ... stylus pressure of 2-6 grammes ... channel difference less than 3 db—at a popular price, with BSR quality and dependability built-in !

Fit this wonderful new ceramic cartridge to your record player—it's obtainable from your local dealer, or if you have difficulty, write to:

Price inc. tax £2·6·5
supplied complete with fixing bracket.

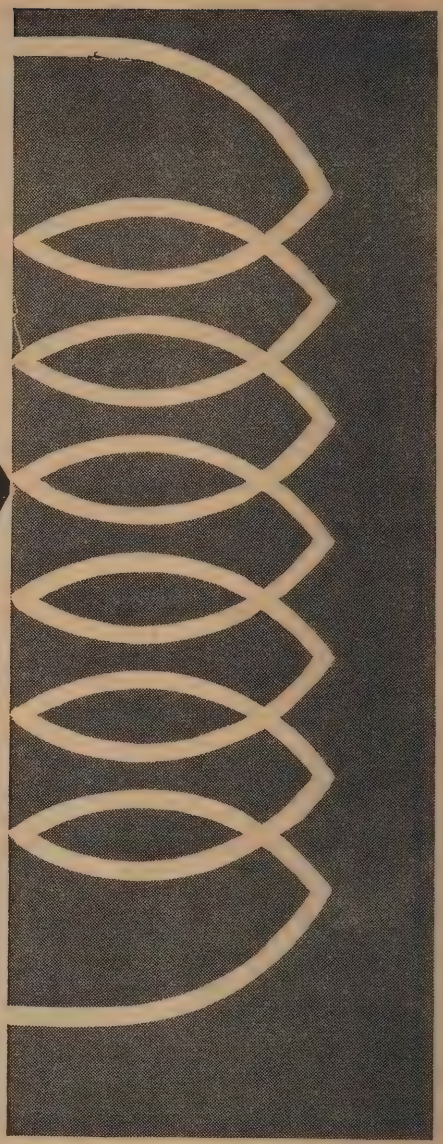
BSR LIMITED · MONARCH WORKS · OLD HILL · STAFFS.

5WW—057 FOR FURTHER DETAILS.

Wherever there is a need to vary AC voltage

YOU NEED THE VERSATILITY OF Variac® REGISTERED

THE ORIGINAL AND BEST VARIABLE TRANSFORMER

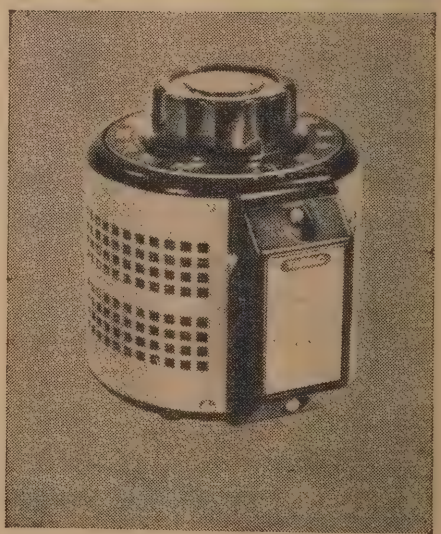


for infinitely variable control of voltage, current, power, speed, heat or light

Variac* is the most useful device yet developed for the control of AC voltage. It provides a smooth continuous adjustment of output voltage, either manually or remotely controlled, from zero to line voltage and above.

Only Variac has Duratrak*—a patented track surface producing longer life, increased overload and surge capacity, and maximum economy in maintenance. The superiority of Variac has been proved in nearly 30 years of continuous service in factories and in laboratories throughout the world.

There are over 200 types of Variac, ranging from single small units for laboratory or instrument use to ganged assemblies for high power 3-phase operation. The range includes portable, open and covered, metal-clad and oil immersed types, dual-output and high-frequency types, plus many 'specials'.



Variac

Variacs are made in England by The Zenith Electric Co. Ltd., London and exclusively distributed in the UK, Eire and British Colonies by Claude Lyons Ltd.

* *Registered Trade Mark*

Claude Lyons

Write for illustrated technical literature to Publicity Department, Hoddesdon.

CLAUDE LYONS LTD. Valley Works, Hoddesdon, Herts. *Hoddesdon 4541 Telex: 22724*
76 Old Hall Street, Liverpool, 3. *MARitime 1761 Telex: 62181*

5WW—058 FOR FURTHER DETAILS.

JACK

the big name in PRE

Precision built radio c
portant contribution
communications indust
and buy Jackson Precisi

DUAL RATIO BALL DRIVE

Inspired by the need for a drive for tuning U.H.F. TV, Ltd. have developed a dual known Ball Drive. (For thi other jobs).
One Coaxial shaft provides 6-1 fast drive.
Only 1⅛" long = 1⅛" diamete (or 6 mm. to special order). optional.
Dual Ratio Ball Drive No. 4 DRF)

CI6 MINIATURE AIR DIELECTIC TRIMMER

Siliconed Ceramic Insulation. Soldered and silver plated Brass Vane Packs. Beryllium Copper Rotor Spring.
Capacities available:—
2.5 pF min. 5 pF swing (Height .4")
3 pF min. 8.5 pF swing (Height .5")
3 pF min. 11.5 pF swing (Height .58").
Temperature Coefficient:— 50 p.
Area ⅛" square. Air Gap .0075".

JACKSON BROS.
DEPT. W.W. KING
CROYDON
Phone: Croydon 2754-5 Gran

5WW—004 FOR FU

Postage will be paid by Associated Iliffe Press

No Postage Stamp necessary if posted in Great Britain or Northern Ireland

BUSINESS REPLY CARD
Licence No. SE 591

WIRELESS WORLD,
DORSET HOUSE,
STAMFORD STREET,
LONDON, S.E.1.

CUT HERE

Wireless World

INFORMATION SERVICE FOR PROFESSIONAL READERS

FEBRUARY 1964 **2**

Please arrange for me to receive further details of the products listed, the appropriate reference numbers of which have been entered in the spaces provided below.

5WW..... 5WW..... 5WW..... 5WW..... 5WW.....
5WW..... 5WW..... 5WW..... 5WW..... 5WW.....
5WW..... 5WW..... 5WW..... 5WW..... 5WW.....
5WW..... 5WW..... 5WW..... 5WW..... 5WW.....
5WW..... 5WW..... 5WW..... 5WW..... 5WW.....

Please specify the actual product where necessary as we cannot forward general enquiries.

.....

Your Name ..... *Position Held*.....

Name of Firm.....

Address .....

.....

Nature of Business.....

CUT HERE

Postage will be paid by Associated Iliffe Press

No Postage Stamp necessary if posted in Great Britain or Northern Ireland

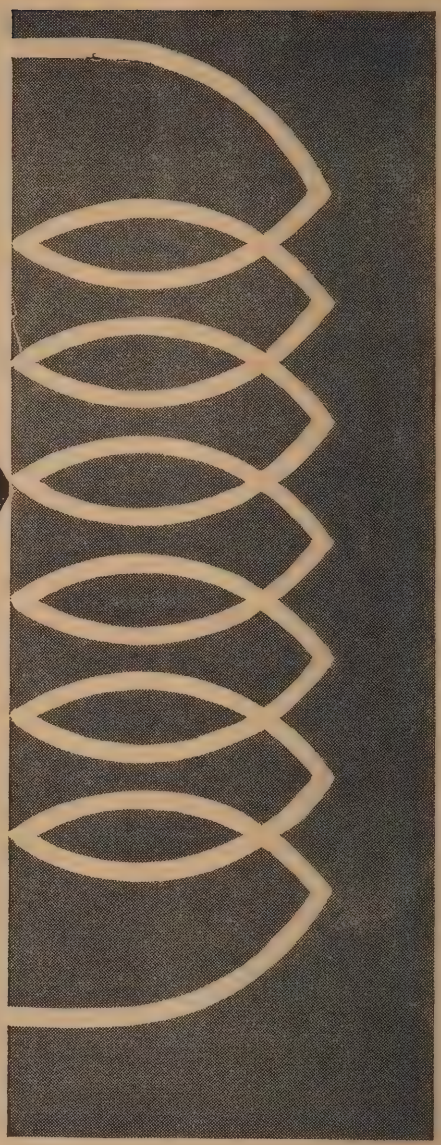
BUSINESS REPLY CARD
Licence No. SE 591

WIRELESS WORLD,
DORSET HOUSE,
STAMFORD STREET,
LONDON, S.E.1.

Wherever there is a need to vary AC voltage

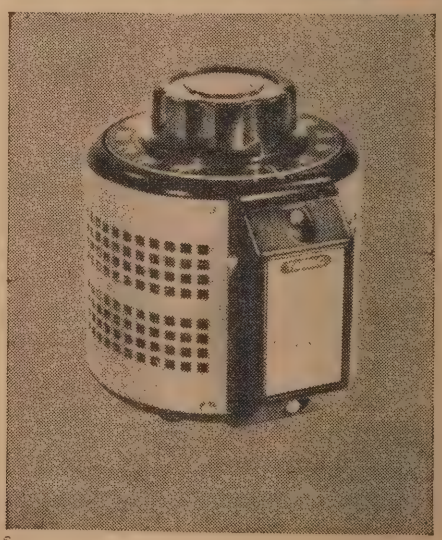
YOU NEED THE VERSATILITY OF Variac®

THE ORIGINAL AND BEST VARIABLE TRANSFORMER



for infinitely variable control of voltage, current, power, speed, heat or light

Variac* is the most useful device yet developed for the control of AC voltage. It provides a smooth continuous adjustment of output voltage, either manually or remotely controlled, from zero to line voltage and above.
Only Variac has Duratrak*—a patented track surface producing longer life, increased overload and surge capacity, and maximum economy in maintenance. The superiority of Variac has been proved in nearly 30 years of continuous service in factories and in laboratories throughout the world.
There are over 200 types of Variac, ranging from single small units for laboratory or instrument use to ganged assemblies for high power 3-phase operation. The range includes portable, open and covered, metal-clad and oil immersed types, dual-output and high-frequency types, plus many 'specials'.



Variac

Variacs are made in England by The Zenith Electric Co. Ltd., London and exclusively distributed in the UK, Eire and British Colonies by Claude Lyons Ltd.

* *Registered Trade Mark*

Claude Lyons

Write for illustrated technical literature to Publicity Department, Hoddesdon.

CLAUDE LYONS LTD. Valley Works, Hoddesdon, Herts. *Hoddesdon 4541 Telex: 22724*
76 Old Hall Street, Liverpool, 3. *MARitime 1761 Telex: 62181*

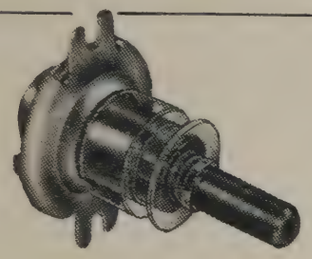
GL4

5WW—058 FOR FURTHER DETAILS.

JACKSON

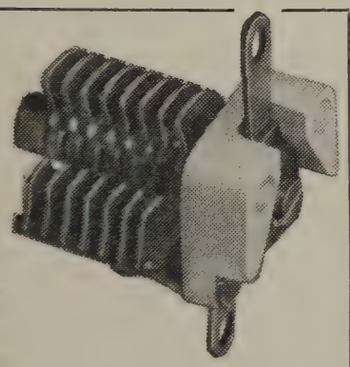
the big name in PRECISION components

Precision built radio components are an important contribution to the radio and communications industry. Be sure of the best and buy Jackson Precision Built Components.



DUAL RATIO BALL DRIVE

Inspired by the need for a small, simple slow motion drive for tuning U.H.F. TV, Jackson Brothers (London) Ltd. have developed a dual ratio version of their well known Ball Drive. (For this—and a thousand and one other jobs).
One Coaxial shaft provides vernier action 36-1 slow, 6-1 fast drive.
Only 1⅛" long = 1⅛" diameter (excluding shaft) ¼" shaft (or 6 mm. to special order). Flange fixing for pointer optional.
Dual Ratio Ball Drive No. 4511 DR (with Flange 4511 DRF)



CI6 MINIATURE AIR DIELECTIC TRIMMER

Siliconed Ceramic Insulation. Soldered and silver plated Brass Vane Packs. Beryllium Copper Rotor Spring.
Capacities available:—
2.5 pF min. 5 pF swing (Height .4")
3 pF min. 8.5 pF swing (Height .5")
3 pF min. 11.5 pF swing (Height .58").
Temperature Coefficient:— 50 p.p.m. per deg. C. End Area ⅛" square. Air Gap .0075".

REGISTERED TRADE MARK

JACKSON BROS. (LONDON) LTD.
DEPT. W.W. KINGSWAY-WADDON, CROYDON, SURREY
Phone: Croydon 2754-5 Grams: Walfico, Souphone, London

5WW—004 FOR FURTHER DETAILS.

Wireless World

INFORMATION SERVICE FOR PROFESSIONAL READERS

To obtain further details of any of the coded items mentioned in the Editorial or Advertisement pages of this issue, please complete one or more of the attached cards entering the reference number(s). Your enquiries will be passed on to the manufacturers concerned and you can expect to hear from them direct in due course. Cards posted from abroad require a stamp.

PLEASE USE CAPITAL LETTERS

Pour obtenir tout autre renseignement sur tout article mentionné dans l'Editorial ou dans les pages publicitaires de ce numéro, nous vous prions de remplir une ou plusieurs des cartes ci-jointes en inscrivant les ou le numéro de référence. Vos demandes de renseignement seront transmises aux fabricants intéressés qui, en temps voulu, vous feront parvenir une réponse. Il est nécessaire d'affranchir les cartes postées de l'étranger.

PRIÈRE D'UTILISER DES CARACTÈRES D'IMPRIMERIE

Weitere Einzelheiten über irgendwelche Artikel, die auf redaktionellen oder Anzeigenseiten erscheinen, erhalten Sie, indem Sie eine oder mehrere der beigefügten Karten ausfüllen und die Kennnummer(n) angeben. Ihre Anfrage wird an den Hersteller weitergeleitet, und Sie werden dann direkt von ihm hören, Karten, die im Ausland aufgegeben werden, müssen frankiert werden.

BITTE IN BLOCKSCHRIFT AUSFÜLLEN

Per ulteriori particolari in merito agli articoli menzionati nel testo o nelle pagine pubblicitarie di questo numero, Vi preghiamo di completare una o piú delle schede allegate citando il numero o i numeri di riferimento. La Vostra richiesta sarà inoltrata ai fabbricanti interessati che Vi risponderanno direttamente. Le schede dall'estero devono essere regolarmente affrancate.

SI PREGA DI COMPILARE LE SCHEDE A STAMPATELLO

Con objeto de obtener mas detalles de cualquiera de los articulos mencionados en las paginas editoriales o de anuncios de este numero, sirvase rellenar una o mas de las unidas tarjetas citando el numero o numeros de referencia. Sus consultas seran transmitidas a los fabricantes interesados de quienes tendran noticias directamente a su debido tiempo. Las tarjetas enviadas desde el extranjero requieren franqueo.

SIRVASE ESCRIBIR CON LETRAS MAYUSCULAS

Wireless World — **INFORMATION SERVICE FOR PROFESSIONAL READERS**

FEBRUARY 1964 — **1**

Please arrange for me to receive further details of the products listed, the appropriate reference numbers of which have been entered in the spaces provided below.

5WW..... 5WW..... 5WW..... 5WW..... 5WW.....
5WW..... 5WW..... 5WW..... 5WW..... 5WW.....
5WW..... 5WW..... 5WW..... 5WW..... 5WW.....
5WW..... 5WW..... 5WW..... 5WW..... 5WW.....
5WW..... 5WW..... 5WW..... 5WW..... 5WW.....

Please specify the actual product where necessary as we cannot forward general enquiries.

.....

Your Name ..... *Position Held*.....

Name of Firm.....

Address .....

.....

Nature of Business.....

CUT HERE

Postage will be paid by Associated Iliffe Press

No Postage Stamp necessary if posted in Great Britain or Northern Ireland

BUSINESS REPLY CARD
Licence No. SE 591

WIRELESS WORLD,
DORSET HOUSE,
STAMFORD STREET,
LONDON, S.E.1.

CUT HERE

Wireless World — **INFORMATION SERVICE FOR PROFESSIONAL READERS**

FEBRUARY 1964 — **3**

Please arrange for me to receive further details of the products listed, the appropriate reference numbers of which have been entered in the spaces provided below.

5WW..... 5WW..... 5WW..... 5WW..... 5WW.....
5WW..... 5WW..... 5WW..... 5WW..... 5WW.....
5WW..... 5WW..... 5WW..... 5WW..... 5WW.....
5WW..... 5WW..... 5WW..... 5WW..... 5WW.....
5WW..... 5WW..... 5WW..... 5WW..... 5WW.....

Please specify the actual product where necessary as we cannot forward general enquiries.

.....

Your Name ..... *Position Held*.....

Name of Firm.....

Address .....

.....

Nature of Business.....

NEW from Advance

SG66

– a low frequency signal generator providing simultaneous sine and square wave output with low distortion down to 5c/s.

Of entirely new design this latest addition to the established range of Advance low frequency signal generators covers in five switch-selectable stages the frequency range 5c/s to 125kc/s. Both sine and square wave outputs are simultaneously available from separate terminals.

With sine wave output alternative impedances of 600Ω floating and 5Ω unbalanced are available with continuously variable output levels from 0 to 30V r.m.s. and from 0 to 1W, respectively.

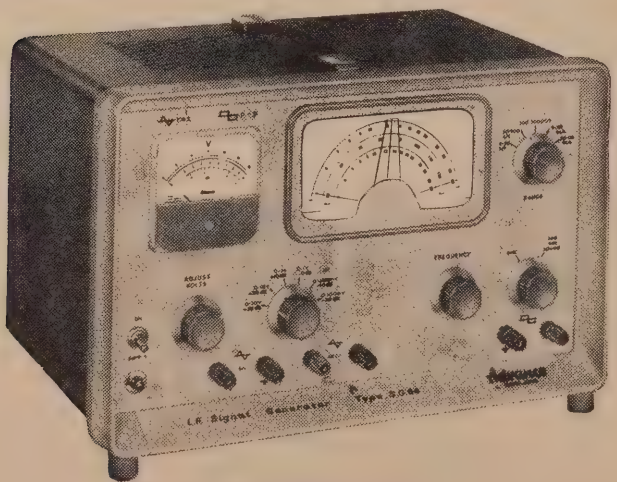
The square wave output is adjustable from 0 to 30V peak to peak, maximum rise and fall time being 0.75μs over the whole frequency range.

- ☐ Distortion less than 1% at 1 watt
- ☐ Push/Pull output
- ☐ Accuracy ±1% or ±1c/s
- ☐ Simultaneous sine and square wave outputs
- ☐ Frequency selected by range switch and easy-to-read calibrated dial
- ☐ Latest Advance styling and colour scheme
- ☐ Low cost – NETT PRICE IN U.K. £65 0s. 0d.

For further details please write to:

ADVANCE COMPONENTS LIMITED
INSTRUMENT DIVISION

ROEBUCK ROAD, HAINAULT, ILFORD, ESSEX, ENGLAND
TELEPHONE HAINAULT 4444 TELEGRAPH ATTENUATE, ILFORD



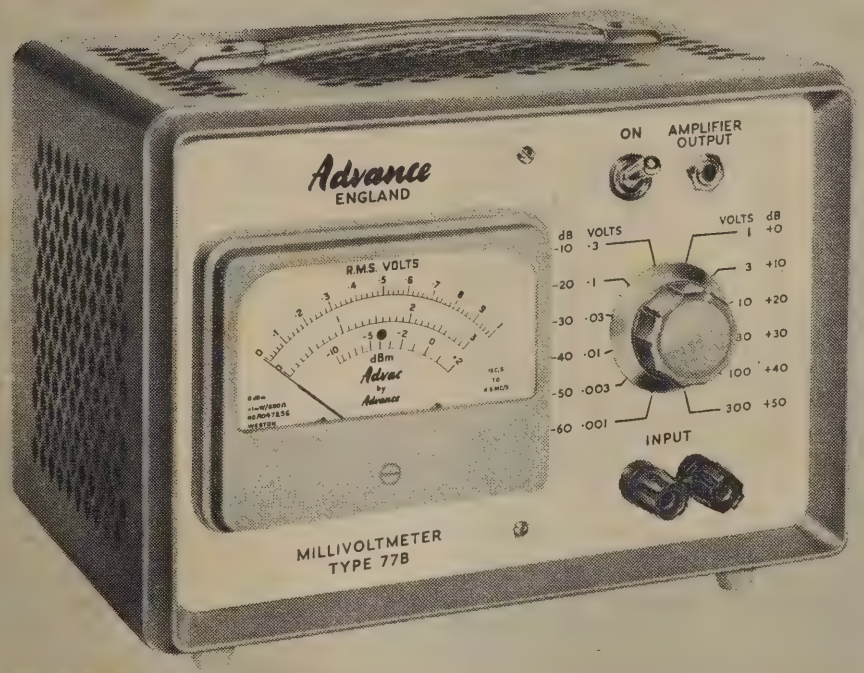
Advance

A1/10

5WW—005 FOR FURTHER DETAILS.

SWITCH TO Advance

for A.C. millivoltmeters



THE A.C. MILLIVOLTMETER VM77B

The VM77B Millivoltmeter is the latest version of the Advac range of instruments with a re-styled case and control panel. Its four-stage amplifier provides twelve ranges between 0.001V and 300V F.S.D. (A.C.) 15c/s to 4.5Mc/s and measurements down to 100μV are possible. Its high input impedance of 10MΩ makes this instrument suitable for all amplifier circuit measurements. A probe accessory (PL45) is available giving a reduced input capacity of 8pF.

● Input impedance 10MΩ, 20pF. ● Frequency range 15c/s to 4.5Mc/s. ● Calibration in both r.m.s. volts and dB referred to 0dBm (1mW in 600Ω). ● Calibration accuracy – 50c/s to 100Kc/s $\pm$ 3% F.S.D.; 15c/s to 2Mc/s $\pm$ (3% + 3% F.S.D.); 2Mc/s to 4.5 Mc/s $\pm$ 2dB. ● Supply voltage range 100 to 125V and 200 to 250V. ● Built-in H.T. stabilisation.

Full technical details and specification are available on request. **NETT PRICE IN U.K. £49**

Advance

BBM A1/4

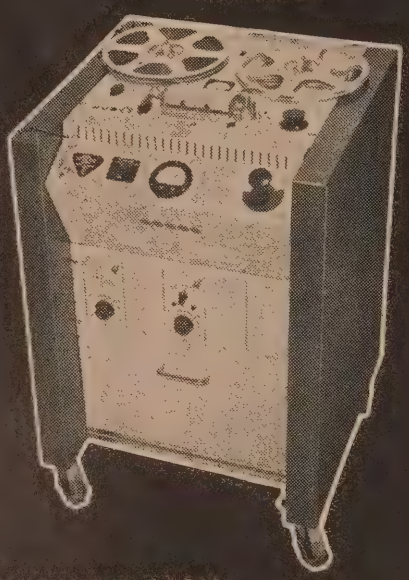
ADVANCE COMPONENTS LIMITED

INSTRUMENT DIVISION

ROEBUCK ROAD, HAINAULT, ILFORD, ESSEX. TELEPHONE : HAINAULT 4444.

5WW—059 FOR FURTHER DETAILS.

SAVE TIME SPACE COST



LEEVERS-RICH
the studio tape recorder with consistent operation and easy maintenance to save your TIME; compact design and mobility to save your floor SPACE; competitive price and negligible upkeep to lower your COSTS. These down-to-earth practical features AND the impeccable LEEVERS-RICH sound quality.

STANDARD studio recorder console (above) with FULL remote control. Single track from £640. 0. 0. Just one example from a complete range of portable, console and rack-mounted recorders for single or multi-track use, including the NEW fully automatic version with photo-electric programming system.
DELIVERY—sooner than you expect for this class of equipment! Inquire NOW:—

LEEVERS-RICH

319b Trinity Road London SW18 VANdyke 9054

5WW—060 FOR FURTHER DETAILS.

MINIATURE IRON (Half Size)

Vari-Stat
THERMOSTATIC SOLDERING IRON
FOR CONTROLLED TEMPERATURE

Miniature Model 50 watt

Weight	1¾ oz.
Heating time	20 secs.
"Push-in" Bit Sizes	3/32", 1/16", 1/32"
Voltage	250 to 12 volts
Price	**55/-**

Instrument Model 70 watt

Weight	4¼ oz.
Heating	1½ min.
Bit Size	11/64" dia.
Voltage	250 to 24 volts
Price	Mk. I (Micro-switch) **79/6**
	Mk. II (Magnetic Contact Breaker) **72/-**

Both Models give excellent bit and element life since the thermostat completely eliminates overheating and controls the reverse heating capacity, which makes possible continuous soldering without chilling of the bit.
The consistent temperature makes these irons ideal for printed circuit work.

CARDROSS ENGINEERING CO., LTD.
Woodyard Road, Dumbarton
Phone: Dumbarton 2655

5WW—061 FOR FURTHER DETAILS.

VACUUM ELECTRONIC LIMITED

KEEPS YOU IN THE PICTURE

WITH THE
FINEST REBUILT CATHODE RAY TUBES
12 MONTHS GUARANTEE

12"—14"	£4-15-0
15"—17"	£5- 5-0
21"	£7-15-0

15/- ALLOWED ON RECEIPT OF OLD TUBE

CASH WITH ORDER OR PRO FORMA, ADD 12/6 FOR CARRIAGE AND INSURANCE
DELIVERY FREE IN LONDON AREA

WRITE, PHONE OR CALL
VACUUM ELECTRONIC LTD
35, SACKVILLE STREET, LONDON, W.1.
REGENT 6404 (5 lines).

5WW—062 FOR FURTHER DETAILS.

On this page for the next few months we shall try to give you, dear reader, some idea of how the name Ernest Turner has come to be synonymous with Quality in the field of Electrical Measuring Instruments.

A very brief history of the company would not be out of place. It was formed in 1922 by the late Mr. Ernest Turner, and commenced production in a small factory on the present site. One of the original buildings is still in use as the Bakelite Moulding Shop, although over the years new structures have sprung up, dwarfing the original workshops.

Each new expansion of the company has been greeted locally with unveiled surprise—it has long been said that in a one-industry town such as High Wycombe, no manufacturer could succeed in any but the staple industry. But today, the firm of Ernest Turner is recognised as one of the leaders of the "non-furniture" industry in the town, with a reputation for low labour turnover resulting from the excellent working conditions and a cheerful, co-operative atmosphere.

At the helm now is Mr. Norman Turner—son of the founder—a well-known figure in local affairs who is, at the same time, on Christian name terms with most of his workpeople and could, if necessary, do any of their jobs as well as they.

Some idea of the wealth of experience and craftsmanship which goes into the making of Ernest Turner instruments can be gathered from the fact that there are now no less than 60 employees with 25 or more years' service to their credit. Next year the total will be 76, and the year after, 98. These "old hands" (and many of them are not so old!) form the nucleus of the company, passing on their wisdom to the newcomers, and setting an example of care and attention to detail applied to every operation.

Many of the features which are now accepted in the design of high quality electrical measuring instruments were originated at Chiltern Works. The movement which forms the basis of the entire range of Ernest Turner moving coil meters has, withstood the changing requirements of official specifications for over twenty years. For example, the specification known as RCS 231/RCL 231 was written around the Ernest Turner H.S. series; now the 2½in. version is the first instrument in the world to receive approval to the new specification DEF.62.

In our next advertisement, in the April issue, we will tell you what we mean by Service to our customers.

The Ernest Turner page

For many years, the Ernest Turner Model W15 circular instrument with a diameter of $1\frac{5}{8}$in. has been the first choice where the requirement is for absolute minimum size and weight.

Now, with the introduction of the Model 701, illustrated above, there is available an attractive, modern instrument only $1\frac{9}{16}$in. x $1\frac{13}{16}$in. utilizing the same movement and with the reliability for which Ernest Turner meters are famous.

Brief technical details of this and other instruments in the Ernest Turner range are given in Catalogue 85/25, available on request from:—

ERNEST TURNER
ELECTRICAL INSTRUMENTS LTD

CHILTERN WORKS · HIGH WYCOMBE
BUCKINGHAMSHIRE · ENGLAND
Tel: High Wycombe 1301

5WW—063 FOR FURTHER DETAILS.

The **only** all-in T.V. tester

THE AIRMEC TELEVET TYPE 259 is the ONLY complete Television Tester—it has every facility for thoroughly checking, repairing, overhauling and aligning TV sets. It covers Bands 1 and III, crystal calibration. Can be used with AC/DC type sets. Completely portable. *Incorporates:* Wobbulator · AM or CW Signal Generator · Pattern Generator · Audio Oscillator · AC and DC (including EHT) voltage measuring facilities · Line transformer test.

WRITE NOW for full details! Immediate delivery
Airmec also make the RADIVET TYPE 211, for AM and FM Receivers.

Airmec Ltd HIGH WYCOMBE BUCKS Tel: High Wycombe 2501/10

SB269

5WW—064 FOR FURTHER DETAILS.

ARE YOU UP TO DATE WITH YOUR SOLDERING TECHNIQUE?

There is a large range of instruments (Bit Dia. 1/32in. to 13/32in.) and accessories marketed under the names of ADAMIN and LITESOLD. May we suggest you apply for the brochures and see for yourself what others are using!

A popular Adamin mains model is the C 10L, shown on a Bench stand which we also manufacture. This model is probably the smallest mains voltage model in the world. BIT DIA. 3/32 in. LENGTH 7 in. WEIGHT ½ oz. (Lessflex). HEATS IN 30 secs.

Brochures A5 and L5 post free from the sole proprietors:—

LIGHT SOLDERING DEVELOPMENTS LTD

28 SYDENHAM ROAD, CROYDON, SURREY. Tel: CROydon 8589

5WW—065 FOR FURTHER DETAILS.

TRANSVERTERS

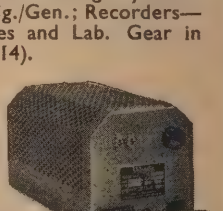
(TRANSISTORISED D.C. CONVERTERS)

2 KW. Peak Starting. 650 W. Continuous. 50-60-400 c/s. or D.C. from 12-24-50 v. Battery. Up to 93% Efficiency. Polarity Reversal Protection. Square or Sinewave. Up to 300% Instant Overload Capacity. Manually Controlled Frequency. Reed Type Indicator. Remote Control Facilities.

Applications: Static "No-Break" Standby Power Supplies; For Vital System(s) Protection, e.g. V.H.F. Transmitters: Industrial Processes; Control-Alarm-Warning Systems: Mobile Use of Counters; Sig./Gen.; Recorders—U/V Sound; Oscilloscopes and Lab. Gear in Marine and Aircraft (K114).

Range of models available with prices from £11-£90.

Please write to department C.10 for transverter leaflet.



Valradio LIMITED

the D.C. conversion specialists since 1935

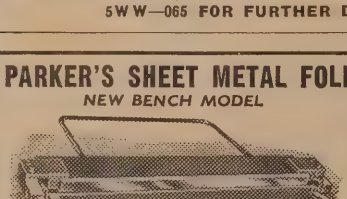
BROWELLS LANE . FELTHAM . MIDDLESEX
Telephone: FELTHAM 4837

Valradio and Stereosonoscope are the registered trade marks of Valradio Ltd.

5WW—066 FOR FURTHER DETAILS.

PARKER'S SHEET METAL FOLDING MACHINES

NEW BENCH MODEL



Capacity 36in. wide x 18-gauge mild steel. Forms channels and angles down to 45 deg., which can be flattened to give safe edge. Depth of fold according to height of bench. Will form flanges. Weight approx. 2 cwt.

Price £23, carr. free. Also the well-known vice models of:

36in. x 18-gauge capacity	...	£11 10 0	Carriage free
24in. x 18-gauge capacity	...	£6 15 0	
18in. x 16-gauge capacity	...	£6 15 0	

One year's guarantee: money refunded without question if not satisfied. Send for details:

A. B. PARKER, Wheatcroft Works
WELLINGTON STREET, BATLEY, YORKS. Tel.: 426

5WW—067 FOR FURTHER DETAILS.

A.C. SOLENOID TYPE SCM

9/10ths FULL SIZE

Continuous 3ozs. at ½".
Instantaneous to 2lbs.
Larger sizes available.
Also—Transformers to 7kVA 3 phase.

R. A. WEBBER LTD.
KNAPPS LANE, CLAY HILL, BRISTOL 5 Phone: 65-7228/9

5WW—068 FOR FURTHER DETAILS.

LAN-POWER

NEW RANGE OF TRANSISTORISED STABILISED LOW VOLTAGE

D.C. POWER SUPPLIES

900 SERIES

LP 100 SERIES. MINIATURES, ENCLOSED CHASSIS
LP 100 SINGLE. 7.5-15 v., 0.5 AMP. VARIABLE.
LP 101 TWIN. 7.5-15 v. × 7.5-15 v. AMP. VARIABLE.

LP 200 SERIES. ENCLOSED CHASSIS.
LP 201 6-28 V. Preset ±1 V., 2 AMP. TWIN.
LP 202 6-12 V. Preset ±1 V., 3 AMP. TWIN.
LP 203 6-28 V. Preset ±1 V., 5 AMP. SINGLE.

LP 400 SERIES. METERED BENCH TYPE.
LP 401 SINGLE. 0-30 V. 0.5 AMP. Continuously variable.
LP 401.T. TWIN 0-30 V. × 0-30 V. 0.5 AMP. Continuously variable.
LP 411 0-30 V. SINGLE. 1 AMP. Continuously variable.
LP 411.T. 0-30 V. × 0-30 V. TWIN AT 1 AMP. Continuously variable.

LP 900 SERIES. METERED. BENCH TYPE. Continuously variable.
LP 901. 0-30 V. SINGLE. 5 AMP. Continuously variable.
LP 902. 0-30 V. SINGLE. 10 AMP. Continuously variable.

LAN-TRAINER, Transistorised Training Modules, NOW OVER 70 CIRCUITS

Increase Production — New 'STIRON' Soldering Irons.
SLASH COSTS with the — 40-50-60 and 75 watt models, PERMANENT STEEL BITS.
NO MAINTENANCE. The most efficient soldering iron in series production.

Details from:-

LAN-ELECTRONICS LTD. **97 Farnham Road, Slough, BUCKS.** *Tel: 26447*

5WW—069 FOR FURTHER DETAILS.

THE PEMBRIDGE COLLEGE OF ELECTRONICS PROVIDES TRAINING IN RADIO AND TELEVISION

FULL-TIME COLLEGE COURSE IN RADIO AND TELEVISION

Our Course has now been extended to sixteen months' duration to include theoretical and practical instruction on transistor television receivers, U.H.F television receivers and colour television.

Next Course commences 15th April, 1964.

This Course is recognised by the Radio Trades Examination Board (R.T.E.B.) for the Radio and Television Servicing Certificate examinations.

Provides excellent practical experience on valve and transistor radio receivers and all well-known makes of television receivers.

To:
The Pembridge College of Electronics (Dept. P10)
34a Hereford Road, London, W.2.

Please send, without obligation, details of the Full-time Course in Radio and Television.

Name .....

Address .....

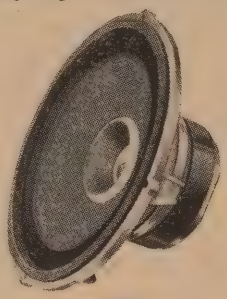
.....

CMP 3

5WW—070 FOR FURTHER DETAILS.

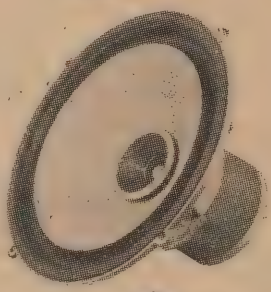
THE WHARFEDALE Super Range

Each loudspeaker in this range is fitted with roll surround for low resonance and double diaphragm assembly for extended HF response.



SUPER 8/RS/DD

Impedance 10/15 ohms
CERAMIC MAGNET
Flux density 14,500 oersteds
Total flux 60,000 maxwells
ALUMINIUM VOICE COIL
Max. input 6 watts rms or 12 watts peak
Frequency range 40-20,000 c/s.
Bass resonance 50/60 c/s.
Price 134/2 inc. P.T.



SUPER 10/RS/DD

Impedance 10/15 ohms
Flux density 16,000 oersteds
Max. input 10 watts rms or 20 watts peak
Frequency range 30-20,000 c/s.
Aluminium voice coil
Roll surround and double diaphragm
Bass resonance 38/43 c/s.
Price 218/8 inc. P.T.

SUPER 12/RS/DD

Impedance 12/15 ohms
Flux density 17,000 oersteds
Total flux 190,000 maxwells
Aluminium voice coil
Max. input 20 watts rms or 40 watts peak
Frequency range 25-20,000 c/s.
Bass resonance 26/32 c/s.
Price 350/- (no tax)

Write for informative and fully illustrated 12 page booklet.

Wharfedale

Wharfedale Wireless Works Ltd., Idle, Bradford, Yorks.
Telephone: Idle 1235/6 Telegrams: 'Wharfdel' Bradford.

5WW—071 FOR FURTHER DETAILS.

WE SPECIALISE IN

EXPORTING
CUSTOM BUILT
QUALITY
SOUND EQUIPMENT TO

all parts of the world

Enquiries invited without obligation. We carry large stocks and offer expert service down to the last detail

All you want in **HI-FI**
TAPE RECORDERS
•
AMPLIFIERS
•
MOTORS & PICK-UPS
•
LOUDSPEAKERS
•
ACCESSORIES

SEND FOR ILLUSTRATED CATALOGUE $1 POST FREE

MODERN ELECTRICS (EXPORT) (RETAIL) LTD
120, SHAFTESBURY AVENUE, LONDON, W.1
(3 mins. from Piccadilly Circus and opposite Columbia Cinema)
Tel: TEM 7587 & GER 9692 Cables: MODCHAREX, LONDON

5WW—072 FOR FURTHER DETAILS.

a new book from PITMAN

Frequency Divider Organs for the Constructor

ALAN DOUGLAS, M.I.R.E., M.A.I.E.E.

Mr. Douglas, well known as the author of " The Electronic Musical Instrument Manual," has now produced this new work for amateur constructors. Full constructional details are given of two systems which produce good conventional tone qualities and yet are equally suitable for new tone colours. A small portable system fully transistorized and operating from dry batteries is also described and outlines of six commercial frequency dividers are given. **25/- net.**

from all booksellers, PITMAN, PARKER ST., LONDON, W.C.2

5WW—073 FOR FURTHER DETAILS.

Have you ever seen a silicon planar with a 25-watt output and gain-bandwidth product up to 300 mc?

Take a look.

Its new configuration makes Bendix® BIG Leaf the silicon planar epitaxial NPN transitor line with the highest power-frequency combination now available: Class C power outputs of 25 watts, gain-bandwidth product to 300 mc. New shape provides a lower collector saturation voltage (typically 0.2 volt at 2 amperes), higher gain and excellent beta linearity at collector currents up to 10 amperes. The gain-bandwidth product (f_t) for the new line results from a new Bendix diffusion technique, large emitter periphery, low capacitance and low base resistance.

Major applications for the BIG Leaf include HF mobile and portable transmitters, high current switching and high frequency inverters. Since the overall efficiency of the unit is much better than a vacuum tube in the same applications, HF, VHF, Class A and Class C amplifier and oscillator applications are attractive possibilities.

For detailed performance data, package sizes and specifications, write us at 605 E. Third Ave., New York 16, N. Y. Cable address: "Bendixint," U.S.A.

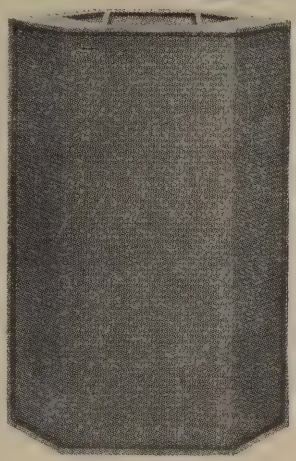
Bendix International Operations

The Bendix Corporation

5WW—074 FOR FURTHER DETAILS.

AIREDALE
FREE STANDING SPEAKER ASSEMBLY

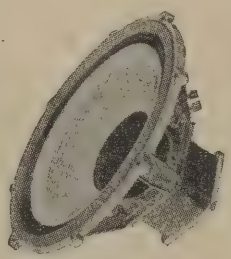
the finest mobile speaker ever to be produced by **WHARFEDALE**



For many years the Wharfedale omni-directional 3-speaker Corner System has been recognised as a superbly natural reproducer, and has frequently stood the difficult test of comparison with live musical performances. The AIREDALE is a free standing version, suitable for corner or along the wall location. Cabinet resonance is avoided by sand filling the front panel and fitting ceramic tiles to rear side panels. Some idea of the solid construction is given by the fact that the total weight exceeds ¾ cwt. Fitted with castors for ease of movement.

SPECIFICATION:

SIZE: 39in. × 28½in. × 14in.
WEIGHT: 91 lb. complete.
IMPEDANCE: 12/15 ohms only.
MAX. INPUT: 20 watts.
Individual controls for middle and treble response are located in the rear panel.
£65, fully finished with a choice of polished walnut or mahogany veneers, or oiled teak.
Oak finish available to special order.
£64 unpolished.
Fully descriptive literature free on request.



In the Airedale

L.F. output is produced by a 15in. unit-type W15/RS, fitted with heavy cone and impregnated cloth roll surround for minimum distortion.

Wharfedale

WHARFEDALE WIRELESS WORKS LTD.
Idle · Bradford · Yorkshire
Tel: Idle 1235/6
Grams: 'Wharfdel' Bradford

5WW—075 FOR FURTHER DETAILS.

Electro-Magnetic Counters

SO MANY FEATURES that we cannot list them all in one advertisement. Some are mentioned below; we shall be happy to show you many more.

Operation DC (4v–230v) or AC (12v–230v with bridge rectifier).

High Speed counting up to 50 impulses/sec.

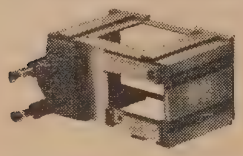
Power consumption as low as 1.0 watt; max. 4.85 watts.

Resetting manual or electrical.

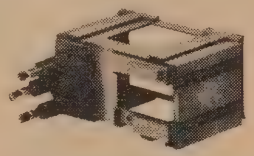
Small dimensions with constant modulus of 25 mm (approximately 1"):

Series F 043 — 50 mm x 25 mm
Series FA 043 — 50 mm x 50 mm

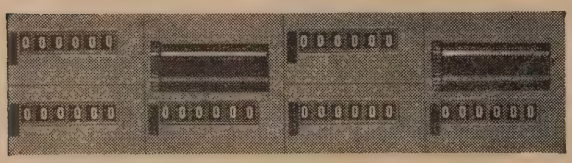
Interchangeable connecting boxes.



2-pole for counter coil



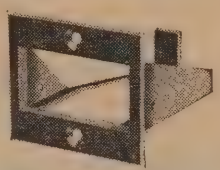
3-pole for contactor with dovetail guides for . . .



Block Assembly, horizontal and vertical, permitting . . .

Quick rearrangement of assembly, sequence or function.

Front Plates available for individual panel mounting.



FULLY ILLUSTRATED DATA FREE ON REQUEST

When you think of a number— think of **HENGSTLER!**

J. HENGSTLER CO. Great Britain LTD.
HIGHBRIDGE STREET WALTHAM ABBEY ESSEX
Telephone: Waltham Cross 26166
Broadway]H303

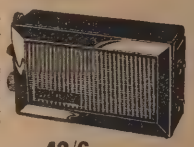
5WW—076 FOR FURTHER DETAILS.

Portable Transistor Sets

Backed by Super After-Sales Service

POCKET FIVE

★ 7 stages—5 transistors and 2 diodes.

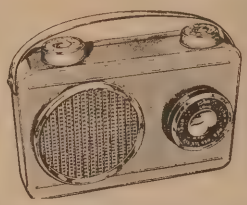


Covers Medium and Long Waves and Trawler Band, a feature usually found in only the most expensive radios. On test Home, Light, Luxembourg and many Continental stations were received loud and clear. Designed round supersensitive Ferrite Rod Aerial and fine tone 2½in. moving coil speaker, built into attractive black case with red speaker grille. Size 5½ × 1½ × 3½in. (Uses 1289 battery available anywhere).

Total cost of all parts now only 42/6 P. & P. 3/-.

Parts price list and easy build plans 1/6.

ROAMER SIX



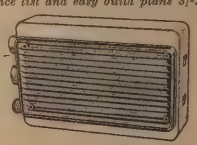
FREE! *Miniature Earpiece, plug and socket (value 9/6) and details of conversion to private listening.*

★ 8 stages—6 transistors and 2 diodes. Listen to stations half a world away with this 5 waveband portable. Tunable on Medium and Long waves, Trawler Band and two Short waves. Sensitive ferrite rod aerial and telescopic aerial for short waves. Top grade transistors, 3-inch speaker, handsome case with gilt fittings. Size 6½ × 4½ × 1½in.

Total cost of all parts now only £4.19.6 P. & P. 3/6.

Parts price list and easy build plans 3/-.

TRANSONA FIVE

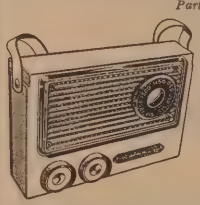


★ 7 Stages—5 transistors and 2 diodes. Covers M. and L. Waves and Trawler Bands, a feature usually found in only the most expensive radios. On Test Home, Light, 208, and many Continental stations wer received loud and clear. Designed round supersensitive Ferrite Rod Aerial and new type fine tone super dy namic 2½" speaker, attractive case in grey plastic with red grille. Size 6½ × 4½ × 1½in. approx. (Uses 1289 battery available anywhere)

Total cost of all parts. NOW ONLY 42/6 P. & P. 3/6.

Parts price list and easy build plans 2/-.

SUPER SEVEN



★ 9 Stages—7 transistors and 2 diodes.

Covers M. and L. Waves and Trawler Bands. The ideal radio can be fitted with carrying strap for outdoor use. Completely portable—built-in aerial for wonderful reception. Push-pull output, 3in. speaker (will drive larger speaker). Size 7½ × 5½ × 1½in. (Uses PP6 battery, available anywhere).

Total cost of all parts now only £3.19.6 P. & P. 3/6.

Parts price list and easy build plans 2/-.

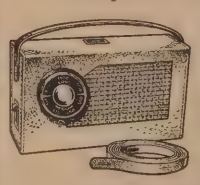
TRANSONA SIX *NEW!!*

★ 8 stages—6 transistors and 2 diodes. A top performance receiver covering full M. and L. Waves and Trawler Bands. High-grade powerful magnet 3in. speaker makes listening a pleasure. Push-pull transformers for ample power. Ferrite rod aerial. Many stations listed in one evening including Luxembourg loud and clear. Attractive case in grey with red grille Size 6½ × 4½ × 1½in. (Carrying Strap 2/- extra). (Use PP4 battery available anywhere).

Total cost of all parts 59/6 P. & P. 3/6.

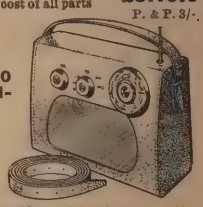
Parts price list and easy build plans 1/6.

MELODY SIX *NEW!!*



★ 8 stages—6 transistors and 2 diodes. Our latest completely portable transistor radio covering M. and L. waves. Incorporates pre-tagged circuit board, 3in. heavy duty speaker, top grade transistors, volume control, tuning condenser, wave change slide switch, sensitive 6in. ferrite rod aerial. Push-pull output. Wonderful reception of B.B.C. Home and Light, 208, and many Continental stations. Handsome leather look pocket size case, only 6¾ × 3¾ × 1¾in. approx. with gilt speaker grille and hand and shoulder straps. *Parts price list and easy build plans* 2/-. **Total cost of all parts £3.19.6** P. & P. 3/-.

ROAMER SEVEN Mk. III



5 WAVEBAND PORTABLE OR CAR RADIO AMAZING PERFORMANCE AND SPECIFICATION.

★ 9 stages—7 transistors and 2 diodes. Covers M. and L. Waves, Trawler Band and two Short Waves to approx. 17 metres. Push-pull output for room filling volume from rich toned heavy duty 5in. speaker. Ferrite rod aerial for M. and L. waves and telescopic aerial for S. Waves. Simulated hide case with gilt trim and shoulder and hand straps. Size 9 × 7 × 4in. approx. The perfect portable and the ideal car radio. (Uses PP9 Battery available anywhere.)

Total cost of all parts NOW ONLY £5.19.6 P. & P. 5/6.

Parts price list and easy build plans 3/-.

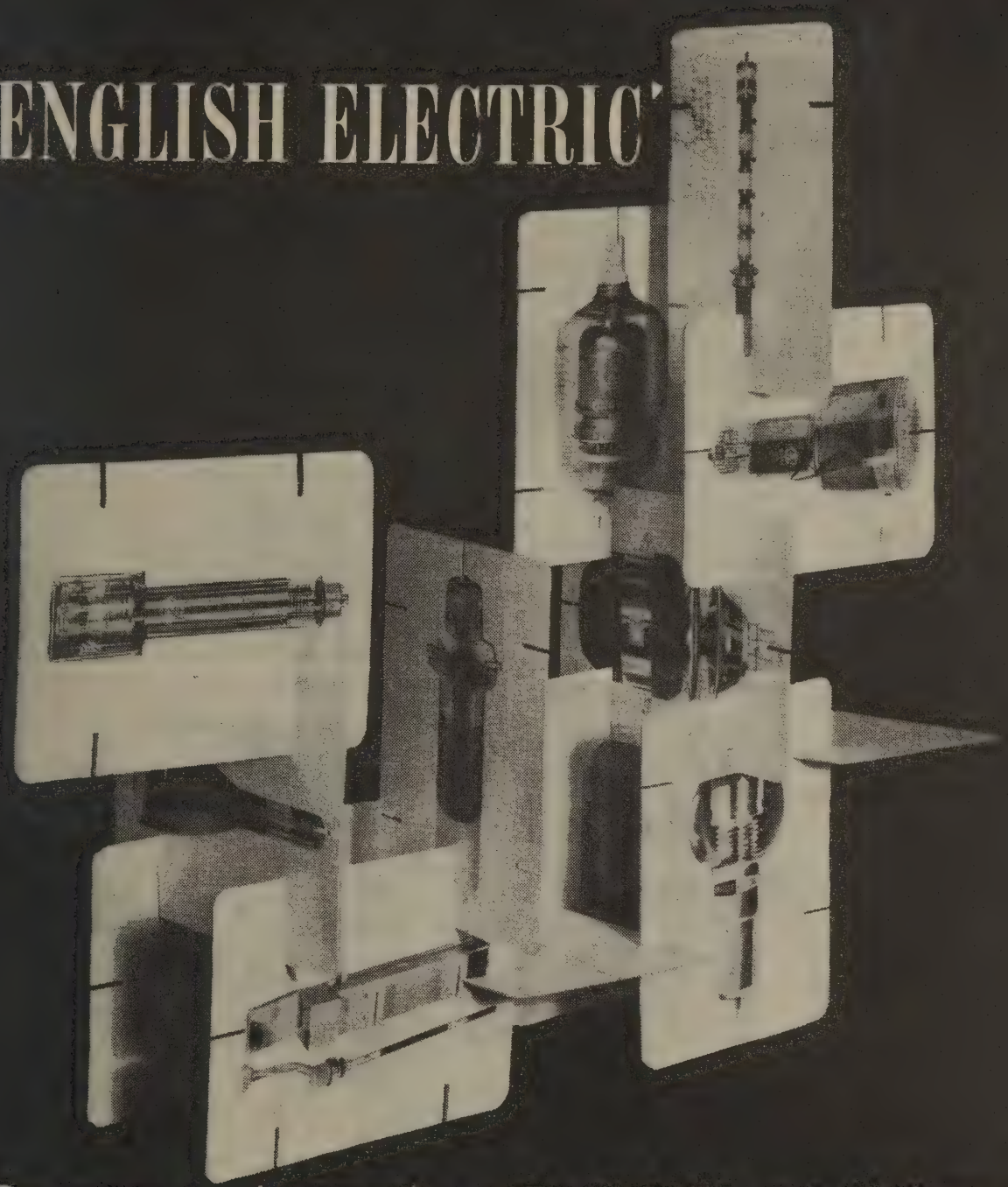
All components used in our receivers may be purchased separately if desired, Parts price lists and easy build plans supplied free with sets of parts or available separately at prices stated. *OVERSEAS POST* 10/-.

RADIO EXCHANGE

27 HARPUR STREET, BEDFORD
Phone 2367 ● Opposite Co-op ● 10-1 p.m. Sats.

5WW—077 FOR FURTHER DETAILS.

'ENGLISH ELECTRIC'



So many projects rely on English Electric Valves

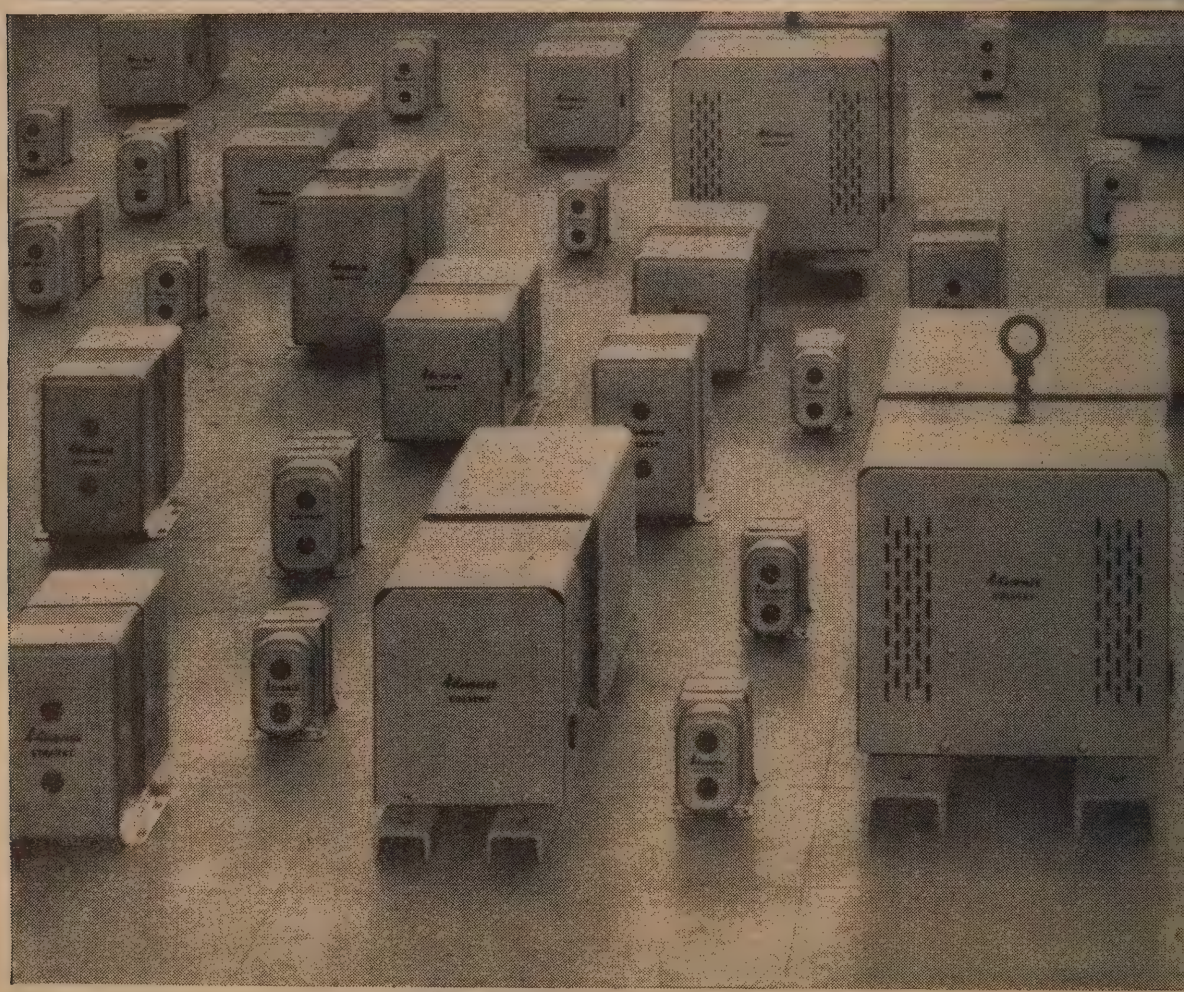
Valves and tubes for radar, industry, communications and television

Backward Wave Oscillators	Pulse Amplifier Valves	Travelling Wave Tubes
Cathode Ray Tubes	R.F. Heating Valves	Trigger Tubes
Image Intensifiers	Storage Tubes	Vacuum Capacitors
Image Orthicons	Thermionic Rectifiers	Vidicons
Klystrons	Thyratrons	Voltage Reference Tubes
Magnetrons	Transmitting Valves	Voltage Stabilisers

ENGLISH ELECTRIC VALVE COMPANY LIMITED

AGENTS THROUGHOUT THE WORLD | Chelmsford, England. Tel: Chelmsford 3491

VOLTAGE STABILISATION BY Advance



5WW—079 FOR FURTHER DETAILS.

the answer to fluctuating voltage

The extensive range of VOLSTAT Constant Voltage Transformers, together with the specialised know-how of the Advance team of design engineers can provide a new stability to your voltage fluctuation problems.

Units from 15W to 10kW rating are standard and include a range of models having as little as 3% harmonic distortion, the latter being most suited for supplying laboratory apparatus and precision electronic equipment.

Design and production facilities allow special units to be built to meet individual specifications. Volstats are used throughout the world as components of critical and sophisticated equipment. When fluctuating voltage affects your production or your products a VOLSTAT is the answer, and a call will bring technical details and full information.

☐ Stabilisation to ± 1% is continuous and automatic from no load to full load for supply variations of ± 15%.

☐ The Volstat range includes models with reduced harmonic distortion limited to less than 5%.

☐ Response time is within approximately 1 cycle of the supply frequency.

☐ No moving parts.

☐ Self-protecting against the effects of short circuits in the load circuit.

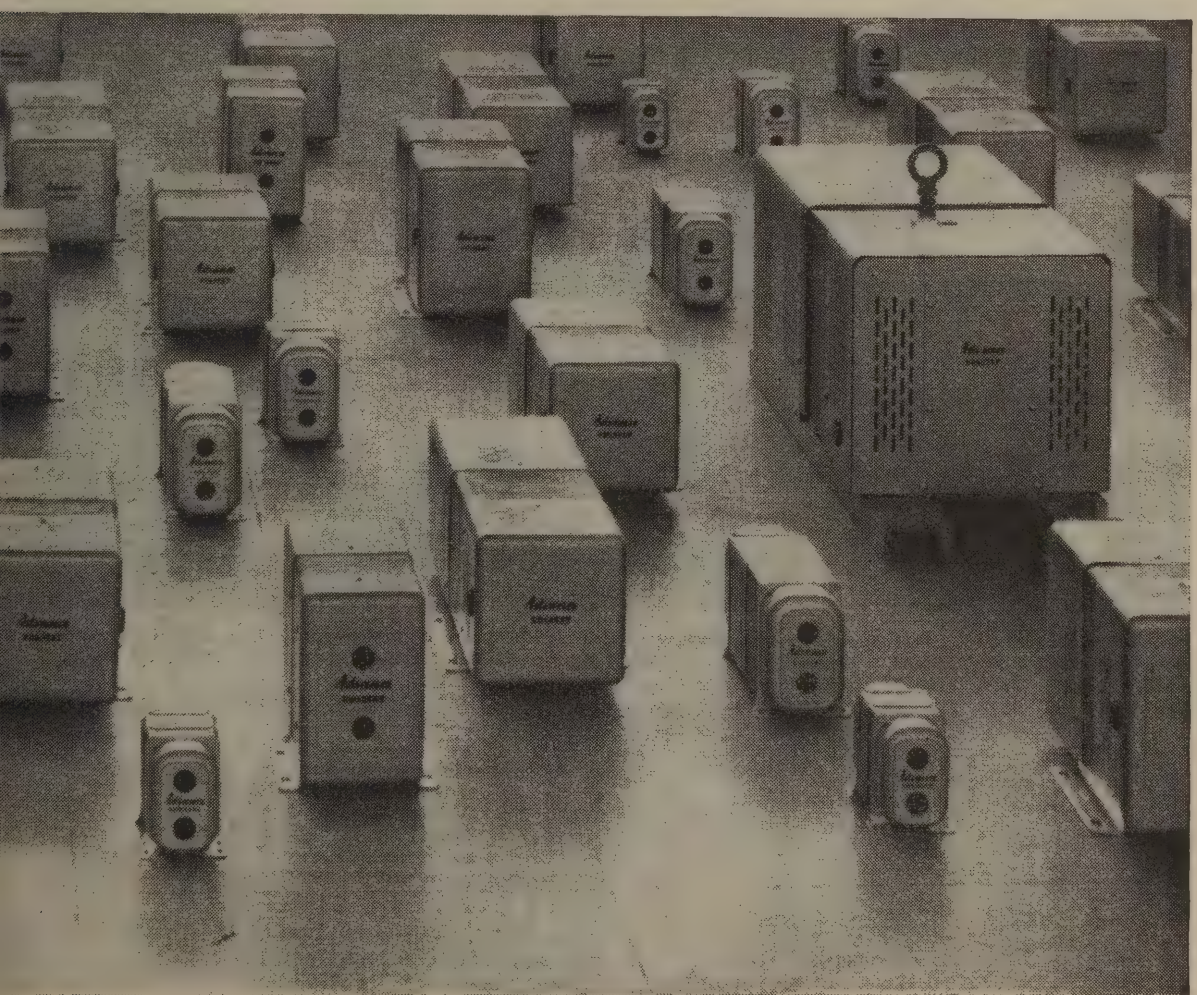
☐ Output is isolated from input and may be connected to earth or primary if desired.

☐ Models can be designed to replace the conventional mains transformer.

☐ Compact design, and various forms of construction to suit individual requirements.

☐ Special design facilities available for customers' production requirements.

ADVANCE COMPONENTS LIMITED
VOLSTAT DIVISION
ROEBUCK ROAD, HAINAULT, ILFORD, ESSEX
TEL: HAINAULT 4444



5WW—080 FOR FURTHER DETAILS. AV/4

RADIO VALVES

HALTRON offers you the most comprehensive stock in the world. 3,000 types of receiving, special purpose, transmitting tubes and transistors available at short notice. A permanent stock of 4,000,000 tubes always ready for prompt despatch. Comprehensive export price list is available at your request.

MINISTRY OF AVIATION APPROVED INSPECTION · AIR REGISTRATION BOARD APPROVED INSPECTION

HALTRON

HALL ELECTRIC LIMITED

Haltron House · Anglers Lane · London N.W.5
Tel: Gulliver 8531 (10 lines) Telex 2-2573
Cables: "HALLECTRIC LONDON NW5".

SWW—081 FOR FURTHER DETAILS.

M. R. SUPPLIES, Ltd.,

(Established 1935)

Known for many years as the most reliable source of the following specialised material —always right up to date. Careful packing—immediate delivery. Prices nett.

SMALL GEARED MOTORS. In addition to our well-known range (List GM/361) we offer smaller open type S.P. units, 200/250v. A.C. 1, 6, 12, 20 or 60 r.p.m. Size approx. 4¼in. × 2½in. × 2in. with 1in. shaft proj. Suitable for display work and many industrial uses. Only **69/6** (des. 2/6).

MINIATURE RUNNING TIME METERS (Sangamo), 200/250 v. 50 c. (synchronous) Counting up to 9,999 hours, with 1/10th indicator. Only 1¼in. square with cyclometer dial, depth 2in. Ideal for use with modern equipment. Immediate delivery, **60/-**, post paid.

MINIATURE VARIABLE TRANSFORMERS (Philips). Another remarkable offer from stock. Open type—panel mount, only 3¼in. diameter, input 200/240 v. Output 0/240 v. 0.5 amp. (in two stages). Many applications including motor and lighting control, **58/6** (despatch 2/6).

SYNCHRONOUS ELECTRIC CLOCK MOVEMENTS (as mentioned and recommended in many national journals). 200/250 v. 50 c. Fitted with spindle for hours, minutes and central sweep seconds hands. Self-starting, central one-hole fixing. Dia. 2¼in. Depth behind dial only 1in. With back-dust cover **29/8** (des. 1/6). Set of three hands, brass, in good plain style. For 5/7in. dial **2/6**. For 8/10in. dial **3/6** set.

MINIATURE COOLING FANS. 200/250 v. A.C., with open type induction motor 2¾in. × 3in. × 1¼in. and 4in. 4-bladed metal impeller. Ideal for projector lamp cooling, convector heaters and light duty extractors, **28/6** (des. 2/-).

EXTRACTOR FANS. Final offer of this very popular and efficient model complete with outside cowling and indoor shutter. Circular motor housing only 4¼in. dia. Easily mounted in small window pane. Silent induction motor, 200/250 v. A.C. (no interference), 3,500 c.ft./hr. Instructions with each. Only **59/6** each (despatch 3/6). We also supply our 8in. model at **£5/5/-** and 10in. model at **£5/12/6** (despatch 3/6). These models are not supplied with outside cowling. Details on request.

SYNCHRONOUS TIMER MOTORS (Sangamo) 200/250 v. 50 c/s. Self starting 2in. dia. × 1¾in. deep. Choice of following speeds 1 r.p.m., 12 r.p.h., 1 r.p.h., 1 rev. 12 hrs., 1 rev. per day. Any one **39/6** (des. 1/6). Also high-torque model (G.E.C.) 2¼ × 2in. × 1¾in., 6 r.p.m. **57/6** (des. 1/6).

SYNCHRONOUS TIME SWITCHES (Sangamo) for accurate pre-set switching operations on 200/250 v. 50 c/s. Providing up to 3 on-off operations for 24 hours of any chosen time, with day-omitting device (use optional). Capacity 20 amps. Compactly housed, 4in. dia., 3¼in. deep. With full instructions. **£5/18/6** (des. 3/-).

COMPLETE SEWING MACHINE MOTOR OUTFITS. No better job obtainable any price, 200/250 v. A.C./D.C. Fitted latest radio/T.V. suppressors. Comprising motor with fixing brackets, foot control and switch, needle light with switch, belt, etc. and instructions for easy fixing to ANY machine. The complete outfit **£6/18/6** (des. 3/6).

NEW F.W. BRIDGE SELENIUM RECTIFIERS. Nominal 12 volts D.C. 1 amp. **8/6**. 2½ amp. **11/6**. 4 amp. **15/6**. Nominal 24 volts D.C. 1 amp. **15/6**. 2½ amp. **22/6**. 4 amp. **27/6**. Postage all models 1/6.

IMMEDIATE DELIVERY of **Stuart Centrifugal Pumps,** including stainless steel (most models). **Philips** Variable Transformers (all models).

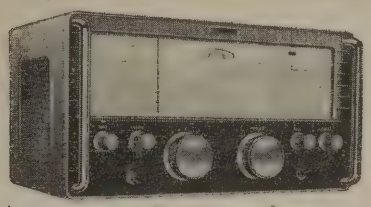
M. R. SUPPLIES, Ltd., 68, New Oxford Street, London, W.C.1.

(Telephone: MUSeum 2958)

5WW—084 FOR FURTHER DETAILS.

EDDYSTONE COMMUNICATION RECEIVERS

For the professional or Amateur user who likes the Best.



840C
£62

Communication receiver at a moderate price. MANUFACTURING STANDARDS OF THE HIGHEST ORDER, 8 B8A valves Superheterodyne circuit. **FREQUENCY RANGES**

Range 1...	12.4—30 Mc/s.	Range 4...	1.12—2.58 Mc/s.
Range 2...	5.2—12.9 Mc/s.	Range 5...	480—1150 kc/s.
Range 3...	2.5—6.1 Mc/s.		

Ranges 4 and 5 include the International Distress Frequencies. Sensitivity better than 10 microvolts. Selectivity 30 db down at 10 kc/s. off resonance, AC/DC. Internal speaker.

HIRE PURCHASE TERMS

Model No.	Cash Price	Desposit	12 Mthly. Payments	24 Mthly Payments
870A	£34 8 9	£5 0 0	£2 12 6	—
840C	£62 0 0	£12 0 0	£4 8 3	£2 6 6
940	£125 0 0	£25 0 0	£8 16 6	£4 14 6
EC10	£48 0 0.	Transistorised Receiver.		

CONFIDENTIAL TERMS. YOU DEAL SOLELY WITH H.P. RADIO.

Carriage paid per passenger train. SATISFACTION GUARANTEED

H.P. RADIO

The Eddystone Specialists

SERVICES LTD.

49/51 COUNTY RD. LIVERPOOL, 4

Telephone: AINTREE 1445 *ESTAB. 1935*

5WW—085 FOR FURTHER DETAINS.

BRITISH NATIONAL RADIO SCHOOL

ESTABLISHED 25 YEARS

PRESIDENT: MR. J. SYKES, M.I.E.E., M. BRIT. I.R.E. G35RK

announces a—

COMPLETE TEACH-YOURSELF PRACTICAL TRAINING PROGRAMME IN

RADIO • TELEVISION • ELECTRONICS

The demand for good Electronic Engineers is increasing almost daily throughout the world. Electronics is now the most rapidly expanding of all industries with its applications reaching into almost every sphere of human activity. If you are looking for a new career with new opportunities—then now is the time to choose—Electronics. If you are already employed in this field—then now is the moment to seek higher qualifications to secure the top jobs which are waiting to be filled. All courses start right from the beginning and no previous knowledge or experience is necessary or expected.

The British National Radio School has had 25 years' experience of HOME STUDY coaching for students wishing to master the fascinating subjects of Electronics—whether the object be career or as a hobby or new interest. The School is entirely independent and specialises ONLY in the teaching of electronic subjects. It employs only fully qualified staff to conduct and supervise each individual course taken by a student and it is this close and personal contact between Tutor and Student which we believe makes possible the successful completion of a course of study.

EXAMINATION COURSES

- CITY & GUILDS TELECOM. TECHNICIANS CERT.
- CITY & GUILDS FULL TECHNOLOGICAL CERT.
- A.M.Brit.I.R.E. EXAMINATION.
- RADIO AMATEURS' LICENCE EXAMINATION.
- P.M.G. CERTIFICATES FOR RADIO OPERATORS.
- R.T.E.B. SERVICING CERTIFICATES.

OTHER COURSES

- MATHEMATICS
- TELEVISION
- TRANSISTORS
- SERVO-MECHANISMS
- COMPUTERS
- RADAR & NAVIGATIONAL AIDS

NEW PRACTICAL & EXPERIMENTAL 'LEARN-WHILST-YOU-BUILD-IT' COURSE IN RADIO & T/V SERVICING

This is a new complete experimental course comprising a mixture of theory and practical work using a very full range of electronic components and apparatus. Starting right from the beginning—or at a later stage if needed—the course enables the student to build up all the basic electronic circuits—amplifier; oscillator, rectifier; detector; etc.—and finally to the design, construction, testing and servicing of a latest design fully transistorised receiver using nine transistors and covering long and medium wave and TWO SHORT WAVE BANDS plus VHF/FM reception. It is of real luxury quality throughout—operates from a 9 v. battery and can be used anywhere in the world. Every present-day technique in circuitry is covered and the course also includes multi-range test meter; signal generator and oscilloscope. By the end of the course the student will be able to deal with any type of servicing work with confidence and will also have a very useful workshop of equipment.

POST NOW FOR FREE BROCHURE →

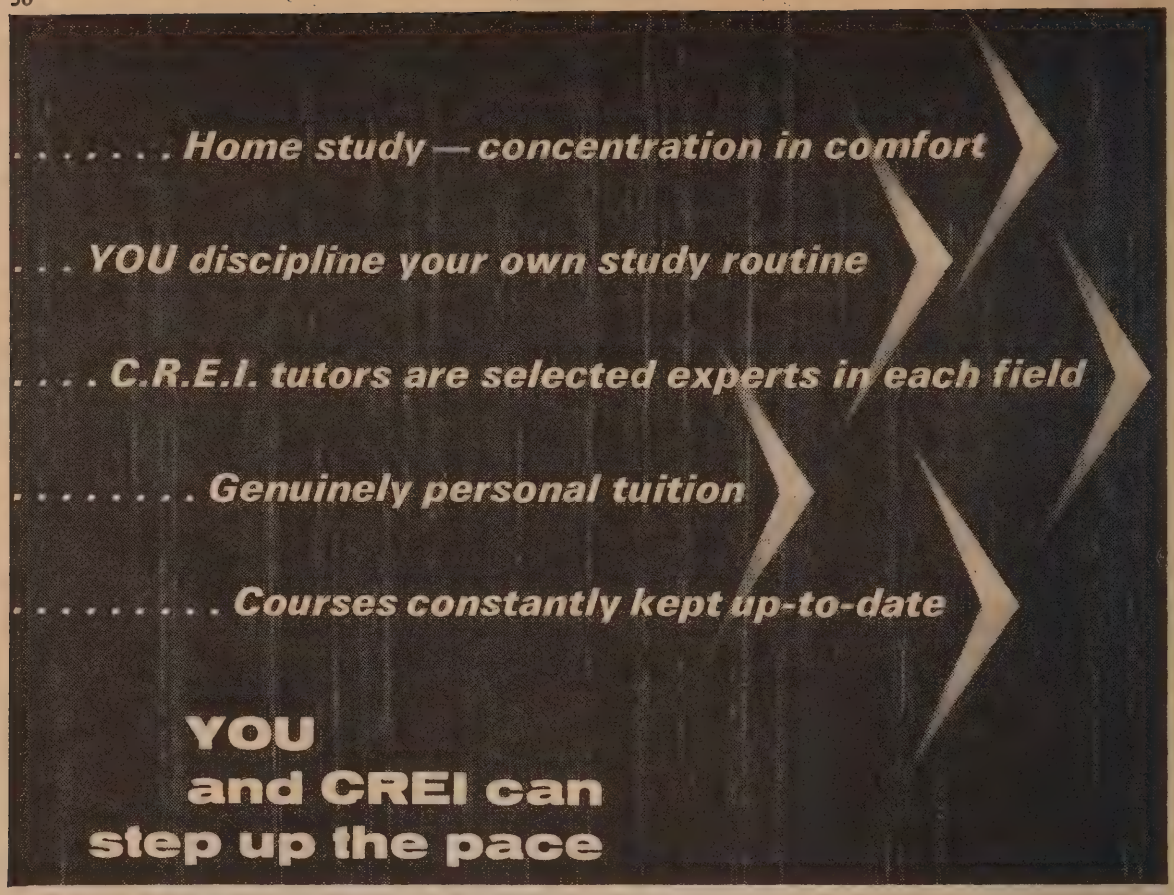
TO: BRITISH NATIONAL RADIO SCHOOL, RADIO HOUSE, READING, BERKS.

Please send details of your Courses, without any obligation, to:—

NAME .....
ADDRESS ..... } Block Caps Please

I am interested in.....course above. WW 2/64

5WW—086 FOR FURTHER DETAILS.


. . . . . Home study — concentration in comfort
. . . YOU discipline your own study routine
. . . . C.R.E.I. tutors are selected experts in each field
. . . . . Genuinely personal tuition
. . . . . Courses constantly kept up-to-date
YOU
and CREI can
step up the pace

of your progress in electronics

The C.R.E.I. System of Home Study Courses in Electronic Engineering Technology has proved to be the most convenient and the most successful form of technical education. The student imposes his own discipline and works at his own pace. C.R.E.I. tuition is genuinely personal with a watchful and friendly relationship between tutor and student. All courses are kept abreast of up-to-date developments. Lessons are prepared by qualified specialists—C.R.E.I. select the leaders in each field. A programme has been specially prepared for the City and Guilds of London Telecommunication Technicians Course 49 and Supplementary Studies 300. If you have had two years in practical electronics, or the equivalent in technical education, write to C.R.E.I. for a free brochure.

C.R.E.I. (LONDON), (DEPT. WW39), GRANVILLE HOUSE, 132-135 SLOANE STREET, LONDON, S.W.1.
MEMBER OF THE CITY AND GUILDS OF LONDON INSTITUTE

FILL IN AND MAIL COUPON

Please send me (for my information and entirely without obligation) full details of the City & Guilds Programme. (C. & G. SUBJECT 49)

☐ 1st yr. ☐ 2nd yr. ☐ 3rd yr. ☐ 4th yr.

☐ Supplementary Studies (Subject 300)

NAME .....

ADDRESS.....

.....

Educational and Technical Background

.....

.....

C.R.E.I. (London), (Dept. WW39), Granville House, 132-135 Sloane Street, London, S.W.1.

Please send me (for my information and entirely without obligation) full details of the Educational Programmes offered by your Institute.

NAME .....

ADDRESS.....

.....

ELECTRONICS EXPERIENCE.....

.....

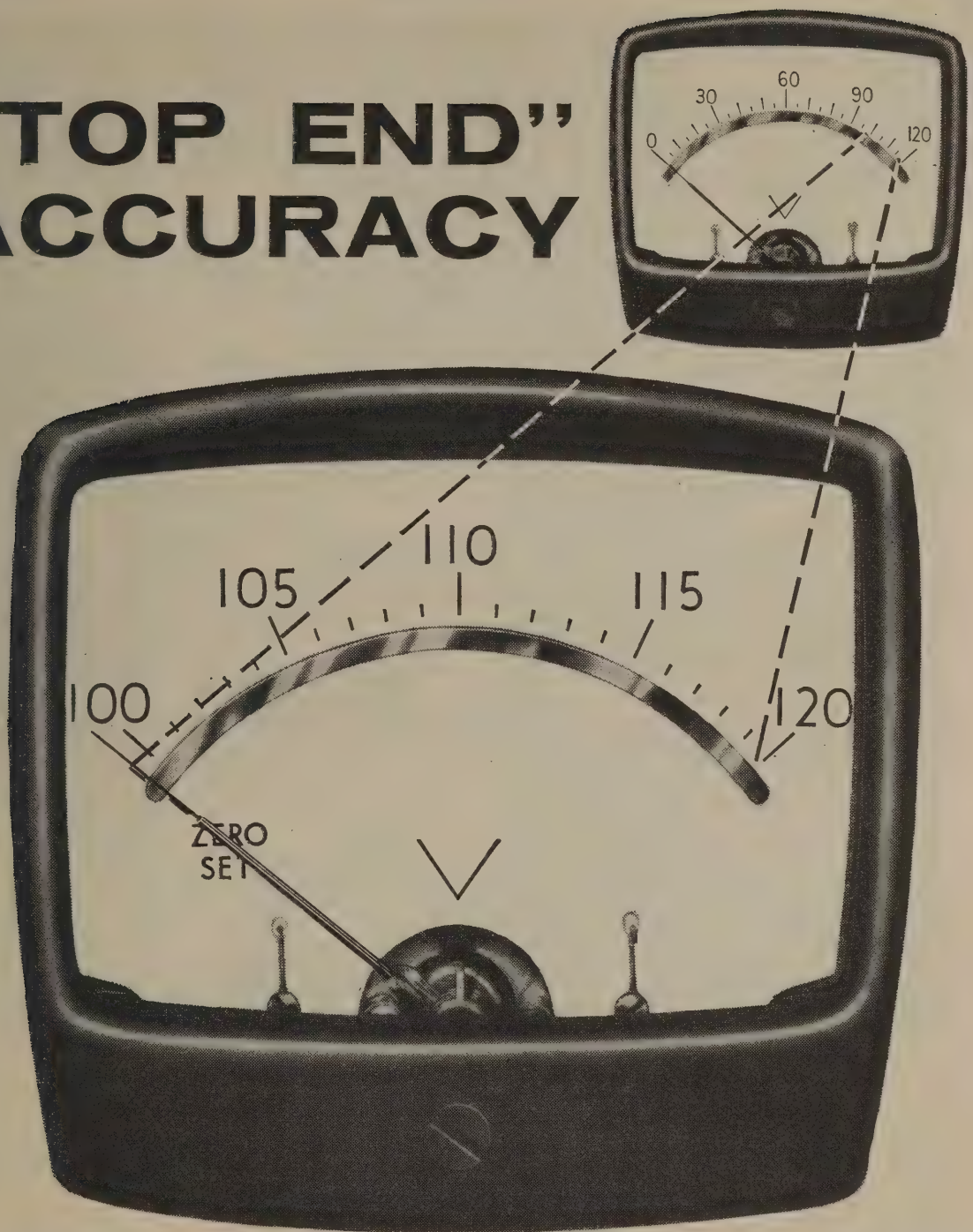
.....

.....

C.R.E.I. (London), (Dept. WW39), Granville House, 132-135 Sloane Street, London, S.W.1.

5WW—087 FOR FURTHER DETAILS.

"TOP END" ACCURACY



...WITH THE **NEW** FERRANTI **SHORT RANGE** VOLTMETERS

NOW AVAILABLE

- ☐ Accuracy within + 0·25% of full scale reading.
- ☐ Available in 2″, 2½″, 3½″, 4″, 6″ and 8″ sizes.
- ☐ Supplied in Style A, Types NF, CF, RP, RF and Hermetically Sealed Cases.

FERRANTI
First into the Future

FERRANTI LTD · MOSTON · MANCHESTER 10 Tel: FAllsworth 2071 · London Office: KERN HOUSE · 36 KINGSWAY, W.C.2, Tel: TEMple Bar 6666
5WW—088 FOR FURTHER DETAILS.

TRACEMANSHIP

The new D43 has the brightest, finest trace yet in a portable double gun oscilloscope. Behind it (literally!) is a new 4" PDA tube operating at 3.5 KV, specially designed for Telequipment, to give greatly improved geometry.

The D43 laboratory oscilloscope has all the established Telequipment features; wide range calibrated time base, selective triggering (now with HF sync.), X expansion control x10 and a unique DC coupled fly-back blanking system. In addition the Y amplifier performance has been greatly improved, the maximum bandwidth of A and C types now being 15Mc/s. The following plug-in amplifiers for double beam model D43 are fully interchangeable with those for single beam version S43.

Type 'A'	General Purpose	DC-15Mc/s at 100mV/cm
Type 'B'	Differential	DC-75Kc/s at 1mV/cm
Type 'C'	Ultra High Gain	3c/s-75Kc/s at 100 μV/cm

The capabilities of Telequipment instruments have been increased steadily in the ten years since the introduction of the Serviscope*, the first truly high performance portable oscilloscope. There is available a complete range of these lightweight, accurate, dependable oscilloscopes all specially developed for your particular industrial, research or teaching application.

Enquiries are always welcome

D43 *with type 'A' general purpose amplifiers* **£125**

A complete specification will be sent on request.

TELEQUIPMENT

** Serviscope is a registered trade mark*

Telequipment Ltd., 313 Chase Road, Southgate, N.14 Fox Lane 1166

5WW—089 FOR FURTHER DETAILS.

Wireless World

ELECTRONICS, RADIO, TELEVISION

CONTENTS

FEBRUARY 1964

Editor:
F. L. DEVEREUX, B.Sc.

Assistant Editor:
H. W. BARNARD

Editorial:
P. R. DARRINGTON
D. C. ROLFE
D. R. WILLIAMS

Drawing Office:
H. J. COOKE

Production:
D. R. BRAY

Advertisements:
G. BENTON ROWELL
(Manager)
J. R. EYTON-JONES

61 Editorial Comment

62 Recent Developments in Automatic Error Correction—1 *by P. R. Keller*

66 Books Received

67 *Wireless World* Oscilloscope—7

71 Letters to the Editor

74 Elements of Transistor Pulse Circuits—2 *by T. D. Towers*

80 Commercial Literature

81 World of Wireless

83 Personalities

85 News from Industry

87 Point-to-Point Review: 1963 *by P. A. C. Morris*

89 Physical Society Exhibition Review

95 Manufacturers Products

101 The Bode Fillet *by T. Poddam*

105 H.F. Predictions—February

106 February Meetings

108 Unbiased *by "Free Grid"*

VOLUME 70 No. 2
PRICE: 2s 6d.

FIFTY-THIRD YEAR
OF PUBLICATION

Managing Director: W. E. Miller, M.A., M.Brit. I.R.E.
Iliffe Electrical Publications Ltd., Dorset House, Stamford Street, London, S.E.1

Please address to Editor, Advertisement Manager or Publisher as appropriate

© **Iliffe Electrical Publications Ltd., 1964.** Permission in writing from the Editor must first be obtained before letterpress or illustrations are reproduced from this journal. Brief abstracts or comments are allowed provided acknowledgement to the journal is given.

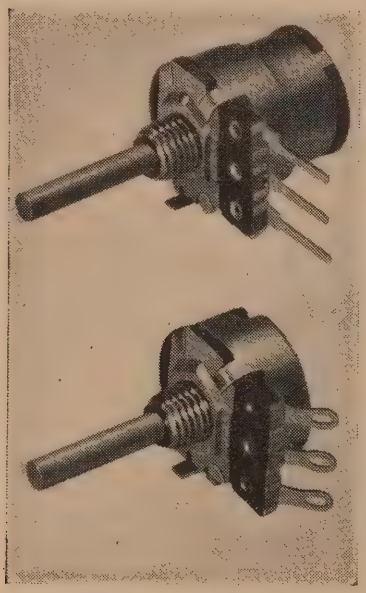
PUBLISHED MONTHLY (4th Monday of preceding month). *Telephone:* Waterloo 3333 (70 lines) *Telegrams:* "Ethaworld London Telex." *Cables:* "Ethaworld, London, S.E.1." *Annual Subscriptions: Home* £2 0s 0d, *Overseas* £2 5s 0d. *Canada and U.S.A.* $6.50. Second-class mail privileges authorised at New York, N.Y. BRANCH OFFICES: *BIRMINGHAM:* King Edward House, New Street, 2. *Telephone:* Midland 7191. *BRISTOL:* 11, Marsh Street, 1. *Telephone:* Bristol 21491/2. *COVENTRY:* 8-10, Corporation Street. *Telephone:* Coventry 25210. *GLASGOW:* 62, Buchanan Street, C.1. *Telephone:* Central 1265-6. *MANCHESTER:* 260, Deansgate, 3. *Telephone:* Blackfriars 4412. NEW YORK OFFICE: U.S.A.: 111, Broadway, 6. *Telephone:* Digby 9-1197.

MINIATURE CARBON POTENTIOMETERS

Robustness and Reliability

Volume and tone controls of modern transistor portables and radios need to be very compact, and the Mullard range of miniature potentiometers—the EO88 range—make it possible for this requirement to be achieved.

These carbon potentiometers are fitted with soldering tags for wire connections, or with three terminal pins for use with



printed-wiring boards. Either version can be obtained with or without a single-pole rotary switch. The range of resistance values obtainable is 1 to 500kΩ, with either a linear or logarithmic law, and the potentiometers are stable over a temperature range of —10 to +70°C. Their diameter is 16mm and spindle lengths of 10, 15 and 20mm are available. These small Mullard potentiometers are outstanding among miniature components for their robust construction, reliability of operation and length of service life.

AC107 LOW-NOISE TRANSISTOR FOR TAPE RECORDERS

The Mullard AC107 low-noise junction transistor is now frequently used as a voltage amplifier in hybrid tape recorders. In this application, it offers the required amplification while introducing the minimum of hum and microphony. In addition to hybrid recorders, the AC107 is particularly suitable for battery-operated all-transistor tape recorders.

Use of the AC107 is not limited to the above equipment, however. Manufacturers of high-quality audio equipment who wish to employ transistor pre-amplifiers because of their inherently good microphony properties are making increasing use of the device. The Mullard AC107 is thus contributing greatly to the high standards attainable with the wide present-day range of audio equipment.

TEMPERATURE COMPENSATION PROLONGS EFFECTIVE BATTERY LIFE

AA129 bias stabilising diode

The AA129 Mullard junction diode is being used in the latest radios to provide compensation for changes in battery voltage and operating temperature.

In portables, the voltage of the batteries used will decrease with life, and the performance of the sets will deteriorate because of an increase in crossover distortion. This effect of decreasing voltage is accentuated as the operating temperature falls. To ensure good battery life, it is desirable

WHAT'S NEW IN THE NEW SETS

These articles describe the latest Mullard developments for entertainment equipment

that the rece vers should be designed to give acceptable performance when the voltage falls to about 50% of the nominal value.

If the AA129 is incorporated in the base-bias network of the output stage of the receiver, the necessary compensation can be achieved. With such an arrangement the voltage can fall well below the 50% limit without the performance of the receiver at extremely low temperatures falling below an acceptable standard. Use of the Mullard bias stabilising diode thus ensures less variation in performance with battery voltage decay and considerably prolongs the useful life of the batteries in a portable radio.

MVE 1500

Wireless World

VOL 70 NO 2 FEBRUARY 1964

The Physics Trade

A PLUMBER, called to attend to a blocked sink in a physical-chemistry laboratory and waiting for the return of his mate with a bigger pipe wrench, is watching through a forest of fractionating columns the dexterous manipulation of a burette by the research worker on the opposite side of the bench. After a time the scientist becomes aware that he is being watched. There is an awkward pause, and it is the plumber who breaks the silence: "Kind of a trade all on its own like, ain't it?"

We are reminded of this story (founded on fact) every time we visit the Physical Society Exhibition which, to give it its full sub-title is an "annual exhibition of scientific instruments and apparatus." It is here that the practical aspect of the scientific process—hypothesis tested by experiment—comes into its own and where as revolutionary changes have taken place in the past 50 years as in theoretical physics.

When we first reported this exhibition (in January 1912) the thermionic valve was still a curiosity and the exhibition was dominated, if not by string and sealing wax, by ebonite and lacquered brass. But by 1921 Prof. Fortescue and Dr. Bryan were able to assemble enough material to read a paper during the exhibition period on "Some of the Uses of the Thermionic Valve," one of many events which signalled the start of what we now term "electronics." Nowadays the kind of experiment required to verify advanced thought on the nature of the material universe requires all the resources of industry in making, mounting and monitoring the necessary giant particle accelerators. Physics must now call on the resources of finance, economics and commerce as well as on engineering.

Herein lies the origin of a dilemma which the Council of the Institute of Physics and the Physical Society has had to face in recent years—how far it should go in admitting or excluding the commercial element. It has always held that the Exhibition is "a scientific occasion rather than one for the display of ordinary commercial products," and it is important here to notice the use of the comparative "rather than" instead of an uncompromising "not." This has permitted flexibility in the interpretation of the rule.

One result of the Council's efforts to restrict commercial activities within the Exhibition has been to foster the growth of extra-mural trade shows of which there were many this year in hotels within easy reach of the Horticultural Halls. If industry can stand the expense we think this is probably the best solution of the problem. It should not be forgotten that physicists want to buy ordinary commercial products, and that the "Phys. Soc." Exhibition, whether the organizers like it or not, provides a powerful stimulus. Most of the research demonstrations by universities and Government establishments are mounted with the help of numerous production oscilloscopes, display units, etc., which would not otherwise qualify for admission, but which nevertheless may be new to some worker on his biannual emergence from the laboratory. It would be convenient if he could discuss the matter in detail at an adjacent trade show before returning to his ivory tower, particularly if he works in the provinces.

Next year the Exhibition will try the experiment of moving to Manchester under the new title of "The Physics Exhibition." We hope the hotel accommodation will be sufficient to house the many research workers who will travel north to see it, together with the firms who will be exhibiting outside as well as inside the exhibition.

Recent Developments in

AUTOMATIC ERROR CORRECTION

1.–ERROR CORRECTING CODES FOR RADIO TELEPRINTER CIRCUITS

By P. R. KELLER,* M.B.E., B.Sc., A.M.I.E.E.

MOST inland telegraph traffic is transmitted over line circuits between teleprinters using the 5-unit C.C.I.T.T. International Telegraph Code No. 2, and the start-stop mode of operation for maintaining synchronism between the transmitting and receiving apparatus.

When this method is used for transmission over an HF radio circuit a proportion of the received characters will often contain errors due to the distortion, noise and fading inherent in this propagation medium. This has led to the development of automatic error correcting equipment for use on radio teleprinter circuits. Before considering the modes of operation of various error-correcting systems, normal teleprinter operation will be reviewed.

The Teleprinter Code:—The code is shown in Table I. It is seen that each character is represented by five elements each of which is in one of two conditions. The use of all arrangements of a 5-element 2-condition code permits 32 different characters to be formed, and the number of symbols which can be printed is increased by using figure and letter cases. Some characters are allotted to machine functional operations which are the same in both cases.

Characters can be transmitted by transmitting all elements together on a 5-wire simultaneous basis (usually only over short distances) or, more generally, by transmitting the elements sequentially.

Start-Stop Operation:—In the start-stop method of transmission, illustrated in Fig. 1, the five information elements are of equal duration and are transmitted in order, preceded by a start element of the same duration, and followed by a stop element. The stop condition is maintained for a minimum period before the start element of the next character is transmitted. When an automatic transmitter is used, the stop period is often nominally 1½ basic element periods, while, with manual keyboard transmission it may be longer and variable. When there is no traffic to be sent the circuit idles in the stop condition. The usual transmission speed is 50 bauds (50 elementary information units per second). At this speed the start element and the five information elements are transmitted for 20 milliseconds. each.

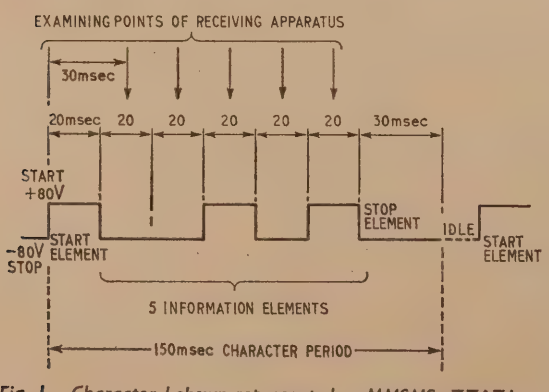


Fig. 1. Character J shown represented as MMSMS, ZZAZA or 11010, together with start and stop elements.

At the receiver, receipt of an element of start polarity prepares the apparatus to take note of the condition of the input wire at five examining points spaced at intervals of 20 msec and beginning 30 msec after the transition from stop to start polarity. As a result, the information elements are sampled at their mid-points and the receiver has maximum margin against distortion in the input signal. An electronic receiver can have a performance in this respect close to the ideal, and correctly interpret the signal with up to 50% distortion, i.e., when the transitions are displaced by up to 10 msec.

The advantage of start-stop operation is that receiver synchronism is accomplished in a simple manner relying only on a knowledge of the nominal transmission speed. Slight speed variations lead to small errors in the examining points, but these errors are not cumulative as the timing for the receipt of each character is reckoned only over the character period, and begins again from the timing of the next start element for the next character.

Signalling Conditions and Designations:—The two signalling conditions used to transmit characters in teleprinter code may be designated by several different systems of symbols, and presented physically in practical transmission systems in a further variety of ways. Since it is convenient at different times to use different terms and symbols some of those most commonly used are shown in Table II.

Transmission Over HF Radio Circuits:—Telegraph transmission over a radio circuit using the teleprinter code and start-stop operation can be effected quite simply by allowing two radio conditions to the start and stop telegraph signalling conditions. As examples, with on/off keying, "carrier off" can represent the start condition and "carrier on" the stop condition, while for frequency shift keying (F.S.K.) on frequency can be transmitted for start and another for stop, and so on.

The advantage of this method is that only simple

* *The Marconi Co. Ltd.*

terminal equipment is required and there is no compatibility problem in connecting to land line networks.

However, if traffic is transmitted in this simple manner direct from a teleprinter, or similar 5-unit apparatus, messages can be corrupted in two ways. Firstly, if one or more of the five information elements of a character is received incorrectly, a wrong character will be printed since all 32 possible arrangements of the five information elements are acceptable to the receiving teleprinter. Secondly, if a start or stop element is received incorrectly, the receiving teleprinter will lose phase temporarily and a number of characters will be printed incorrectly until phase is regained.

Synchronous Transmission:—Errors due to the incorrect receipt of a start or stop element can be overcome by synchronous working, which involves discarding the start and stop elements before transmission and re-inserting them correctly at the receiver, thus reconstructing a start-stop signal to drive the teleprinter. For synchronous working more complicated circuits are required, as the receiver must be synchronized, and phased correctly, to the incoming signal, but this method can reduce the printed error rate by about 75% even when the "unprotected" 5-unit teleprinter code is retained.

Protected Codes:—Further reduction in the printed error rate can be obtained by using a "protected" code, permitting error correction, in place of the teleprinter code, for transmission over the radio path. The error correcting terminals will generally provide automatic translation between the teleprinter code and the protected code to permit integration with normal teleprinter apparatus, or networks, at the ends of the radio link.

The protected codes have error detecting or error correcting properties, or both, depending on the other characteristics of the system. They always possess "redundancy" in the sense that only some of the possible arrangements of the elements of each character are transmitted and are acceptable to the receiver.

Error Detecting Codes:—For major point-to-point systems the method generally employed involves the use of an error detecting code in which individual 5-unit characters in teleprinter code are translated to 7-unit characters each of which contains three elements of mark polarity and four elements of space polarity. The code is shown in Table III. Of the 128 possible arrangements of the elements of a 7-unit code, 35 have this characteristic and are allocated to the 32 characters in teleprinter code and to 3 supervisory conditions. All errors affecting an odd number of elements in a character, and some errors affecting an even number of elements, can be detected at the receiver by inspection of the mark/space ratio. On detecting an error printing is stopped and a special signal requesting a repetition is returned to the transmitting terminal. Receipt of this signal causes a number of characters, which include the erroneously received character, to be re-transmitted automatically from a storage device. Printing is resumed at the end of the repetition process. Transpositions, involving a mark element interpreted as a space together with a space element interpreted as a mark in the same character, lead to undetectable

TABLE I

The Teleprinter Code

C.C.I.T.T. International Telegraph Alphabet No. 2

Permutation No.	Figure Case	Letter Case	5-Unit Code
1	—	A	Z Z A A A
2	?	B	Z A A Z Z
3	:	C	A Z Z Z A
4	Who are you?	D	Z A A Z A
5	3	E	Z A A A A
6	%	F	Z A Z Z A
7	@	G	A Z A Z Z
8	£	H	A A Z A Z
9	8	I	A Z Z A A
10	Bell	J	Z Z A Z A
11	(	K	Z Z Z Z A
12	)	L	A Z A A Z
13	.	M	A A Z Z Z
14	,	N	A A Z Z A
15	9	O	A A A Z Z
16	0	P	A Z Z A Z
17	1	Q	Z Z Z A Z
18	4	R	A Z A Z A
19	!	S	Z A Z A A
20	5	T	A A A A Z
21	7	U	Z Z Z A A
22	=	V	A Z Z Z Z
23	2	W	Z Z A A Z
24	/	X	Z A Z Z Z
25	6	Y	Z A Z A Z
26	+	Z	Z A A A Z
27	Carriage return		A A A Z A
28	Line feed		A Z A A A
29	Figure shift		Z Z A Z Z
30	Letter shift		Z Z Z Z Z
31	Space		A A Z A A
32	Unperforated tape *Error Symbol		A A A A A

A = Element of Start Polarity
Z = Element of Stop Polarity

TABLE II

Signalling Conditions and Designations For Teleprinter Operation

		One Condition	Other Condition
Designation	C.C.I.T.T. System	Start Space(S)	Stop Mark(M)
	Mathematical Representation	A	Z
		0	1
Signalling Practice	U.K. Practice	+80V	—80V
		—80V	+80V
	Loop Signalling	No Current	Current
	Tape Operation	No Hole	Hole
	Freq. Shift Operation	f1	f2

TABLE III

The Teleprinter Error Detecting Code
C.C.I.T.T. International Telegraph Alphabet No 2

Permutation No.	Figure Case	Letter Case	5-Unit Code	7-Unit Code
1	—	A	Z Z A A A | Z	Z Z A A Z A Z
2	?	B	Z A A Z Z · Z	Z Z A A Z Z A
3	:	C	A Z Z Z A | Z	A Z Z A A Z Z
4	Who are you?	D	Z A A Z A | Z	Z Z A A A Z Z
5	3	E	Z A A A A · Z	Z A A A Z Z Z
6	%	F	Z A Z Z A | Z	Z Z A Z Z A A
7	@	G	A Z A Z Z | Z	A A Z Z Z Z A
8	£	H	A A Z A Z · Z	A Z A Z Z A Z
9	8	I	A Z Z A A | Z	A A A Z Z Z Z
10	Bell	J	Z Z A Z A | Z	Z A Z Z Z A A
11	(	K	Z Z Z Z A | Z	Z Z Z A Z A A
12	)	L	A Z A A Z | Z	A A Z Z Z A Z
13	.	M	A A Z Z Z · Z	A Z A Z Z Z A
14	,	N	A A Z Z A | Z	A Z A Z A Z Z
15	9	O	A A A Z Z | Z	A Z Z Z A A Z
16	O	P	A Z Z A Z · Z	A Z Z A Z A Z
17	1	Q	Z Z Z A Z | Z	Z Z Z A A Z A
18	4	R	A Z A Z A | Z	A A Z Z A Z Z
19	!	S	Z A Z A A | Z	Z A Z A Z A Z
20	5	T	A A A A Z · Z	A Z Z Z A Z A
21	7	U	Z Z Z A A | Z	Z A A Z Z A Z
22	=	V	A Z Z Z Z · Z	A Z Z A Z Z A
23	2	W	Z Z A A Z | Z	Z A Z Z A Z A
24	/	X	Z A Z Z Z | Z	Z Z A Z A A Z
25	6	Y	Z A Z A Z · Z	Z Z A Z A Z A
26	+	Z	Z A A A Z | Z	Z A A Z Z Z A
27	Carriage Return		A A A Z A | Z	A Z Z Z Z A A
28	Line Feed		A Z A A A · Z	A Z A A Z Z Z
29	Figure Shift		Z Z A Z Z | Z	Z A Z Z A A Z
30	Letter Shift		Z Z Z Z Z | Z	Z Z Z A A A Z
31	Space		A A Z A A | Z	A A Z A Z Z Z
32	Unperforated Tape *Error Symbol		A A A A A · Z	Z Z Z Z A A A
33	Idle Beta Signal Normally Cont. Stop Polarity		Z Z Z Z Z A	Z A Z A A Z Z
34	Idle Alpha signal Normally Cont. Start Polarity		A Z Z Z Z A	Z A Z A Z Z A
35	R Q Signal		A A Z Z Z A	Z A A Z A Z Z

A = Element of Start Polarity.
Z = Element of Stop Polarity.

errors and incorrect printing. However, the probability of such errors is low, and this system will reduce the error rate by orders of magnitude. Error detecting and correcting terminals of this type, operating on the principle of correcting errors by the automatic repetition of detected errors (ARQ), will generally also make provision for combining two or four teleprinter channels in time division multiplex. In this case the equipment characteristics have been internationally standardized.[4, 5]

ARQ systems can evidently only be operated on point-to-point circuits and where a return channel is available. For broadcast systems, or point-to-point circuits where a return channel is not available, some other method of error protection must be employed. In these cases an error correcting code can be used employing greater redundancy than a simple error-detecting code, as described above, and permitting the majority of errors to be corrected without reference back to the transmitting terminal.

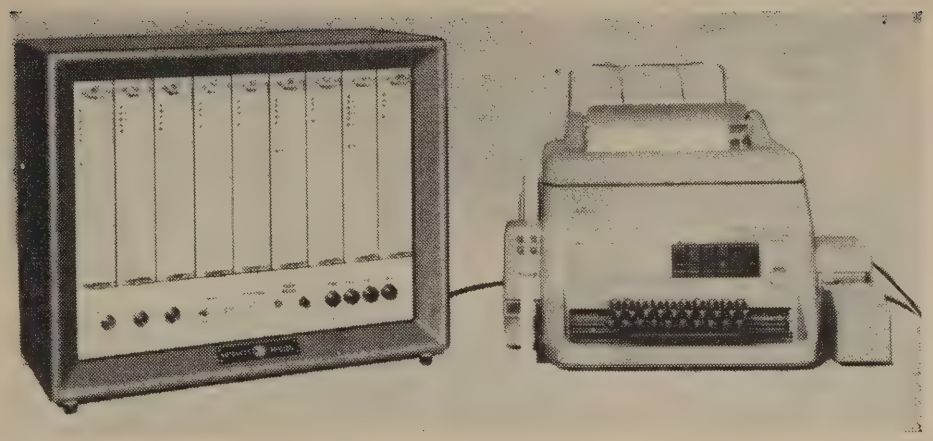
Error Correcting Code:—In a classic paper,[6] to which reference is often made, R. W. Hamming established basic rules for error detecting and error correcting codes, and indicated some of the ways in which such codes might be constructed by adding parity digits to groups of digits representing characters in a non-redundant unprotected code.

From these rules we know that in the case where the unprotected code has 5 elements, the minimum number of elements in the characters of a code permitting single-element errors to be detected is six, and the minimum number of elements in the characters of a code permitting single element errors to be corrected is nine, while at least ten elements are required in each character to permit single element errors to be corrected and errors affecting two elements to be detected.

In the latter case the characters of the new code have twice as many elements as the number of information elements in the characters of the original code. By grouping two or more teleprinter characters together, and operating on a group of ten or more digits, the proportion of parity or check digits will be reduced, but so will the effectiveness of single error correction on a circuit of given basic performance, while the complications of the terminal equipment will increase.

Practical System Requirements:—A system for transmitting teleprinter traffic over an HF radio circuit, and providing error protection by use of an error correcting code, should have the following characteristics:

(a) Any single element error in a character should be corrected automatically.
(b) Most multiple element errors in a character should be detectable, rather than result in a false correction, so that these uncorrectable errors may be indicated in the printed copy.
(c) As a corollary to (a) and (b), the number of undetectable errors, leading to the printing of an incorrect character, should be a minimum.
(d) Operation must be synchronous (if not, the performance would be little better than start-stop teleprinter code working).
(e) Phasing should preferably be automatic so that the equipment can be added to existing



Marconi "Autospec" error correcting equipment with receiving teleprinter.

networks with no change in operational procedure.

(f) A return channel should not be required.

A 10-Unit Error Correcting Code for Teleprinter Circuits:—It has previously been proposed to transmit 5-unit teleprinter characters twice as a means of obtaining an error detection facility by comparing the pairs of characters element by element. In certain cases, where the probabilities of mark and space errors are not equal, transmitting twice can give error correction, but for most modern transmission methods, F.S.K., F.M.V.F., etc., this is not possible.

A 10-unit error correcting code can be constructed by the Hamming method,[6] but for the special case where the unprotected code has 5 elements an equally effective 10-unit error correcting code can be devised, by an alternative method giving greater circuit simplicity in a practical equipment design, as follows:

Principles of Coding

In this method as many parity checks are made, each leading to the addition of a parity digit, as there are elements in the original character, each check covering the elements of the original character excluding one element at a time in turn.

The operation of the method is best seen by an example.

Take the case where the information elements of the 5-unit teleprinter character can be written as 01101, where 1 represents an element of mark (stop) polarity and 0 an element of space (start) polarity. Let us arrange that the first check digit is made 1 or 0 so that together with the four elements of the original character, excluding the first element, we obtain an odd number of 1 elements. The second check digit is made 1 or 0 so that together with the four elements of the original character, excluding the second element, we obtain an even number of 1 elements. The third check digit is made 1 or 0 so that together with the four elements of the original character, excluding the third element, we obtain an odd number of 1 elements. The fourth check digit is made 1 or 0 so that together with the four elements of the original character, excluding the fourth element, we obtain an even number of 1 elements. The fifth check digit is made 1 or 0 so that together with the four elements of the original character, excluding the fifth element, we obtain an odd number of 1 elements. The resulting character in error correcting code is then

0110100111

writing the original five elements in order in the first five element positions of the new character, and adding the check elements in sequence. In practice, of course, the ten elements can be transmitted in any order, provided that the receiver is programmed to take note of the order. Further it is evident that we could have arranged for any of the checks to give odd or even results, each different arrangement leading to a different set of 10-unit characters.

Principles of Reception:—At the receiving terminal similar checks are carried out on received characters. Five checks are made, each covering four elements from the first five together with the appropriate parity element from the last five. The results of the checks may be written in order in an electronic register expressing a correct check result as 0 and an incorrect check result as 1, so that for a character unmutilated in transmission the checks register shows 00000 and the first five elements for the character may be transmitted unaltered, but with start and stop elements added, to the receiving teleprinter. If a single error affects one of the first five elements the check register will contain only one 0 in the position corresponding to the faulty element, which can then be inverted before being transmitted to the teleprinter. If the single error affects one of the second five elements, the check register will contain only one 1, and the first five elements can be transmitted to the teleprinter unchanged. Any double errors, and many multiple errors, will result in the check register, containing 11111, or 111 with 00 in any arrangement, or 11 with 000 in any arrangement. In a practical system the teleprinter can be arranged to print an error symbol when these indications are given by the check register.

Examples:

Teleprinter signal	01101
Transmitted signal	0110100111
(a) Received signal (no errors)	0110100111
Check result	00000
5-unit output	01101

(b) Received signal (third element in error) 0100100111
Check result 11011
5-unit ouput 01101 (Third element in error and reversed as one 0 in third position of check result.)

(c) Received signal (ninth element in error) 0110100101
Check result 00010
5-unit output 01101 (First five elements accepted as check result shows only one 1).

(d) Received signal (double error affecting third and fourth elements) 0101100111
Check result 00110
5-unit output Error symbol (Because check result gives 11 with 000).

In this example it appears that the double error could have been corrected, but the same check result might have been obtained from a multiple error as in the next example.

(e) Received signal (quadruple error) 0000101101
Check result 00110
5-unit output Error symbol

(To be concluded)

REFERENCES

1. P. R. Keller: "Automatic Error Correction on HF Telegraph Circuits," *Point-to-Point Telecommunications*, Vol. 2, No. 2 (1958).
2. P. R. Keller and L. K. Wheeler: "Automatic Error Correction," *Wireless World*, January, 1959.
3. P. R. Keller and A. J. Wheeldon: "Recent Improvements in Automatic Error Correcting Systems for HF Telegraph Networks," *Point-to-Point Telecommunications*, Vol. 6, No. 2 (1962).
4. Recommendation No. 242 C.C.I.R. Green Book (Los Angeles 1959), Vol. 1, p. 130.
5. Report No. 108 C.C.I.R. Green Book (Los Angeles 1959), Vol. 3, p. 70.
6. R. W. Hammings: "Error Detecting and Error Correcting Codes." *Bell System Technical Journal*, April, 1950.
7. A. C. Croisdale: "Automatic Error Correcting Systems used on HF Radio Links," *I.E.E. Convention on HF Communication*, March, 1963, Fig. 15.

Books Received

Principles of Feedback Design by G. Edwin and Thomas Roddam. Essentially a working guide to the understanding and solution of feedback problems in electronic circuits, taking as a first example the step-by-step synthesis of the response of a three-stage valve amplifier, this book also affords an insight into the broader aspects of closed-loop systems and conditions for stability. Other topics discussed are signal-flow diagrams and feedback amplifiers as filters. Pp. 238. Iliffe Books Ltd., Dorset House, Stamford Street, London, S.E.1. Price 45s.

Principles and Practice of Radar, by R. S. H. Boulding, O.B.E., B.Sc., M.I.E.E., A.M.I.Mech.E., F.Inst.P. Seventh edition, revised and reset, gives a broad and comprehensive introduction to principles and practice. Pp. 851. George Newnes Ltd., Tower House, Southampton Street, London, W.C.2.

Dictionary of Modern Acronyms and Abbreviations, by Milton Goldstein, Ph.D. Over 6,000 coined words and abbreviations (chiefly American) in electronics and allied fields. Pp. 158. Howard W. Sams & Co. Inc., Indianapolis 6, Indiana, U.S.A. Price $4.95.

International Series of Monographs on Electronics and Instrumentation. (Pergamon Press, Headington Hill Hall, Oxford.)

Static Electromagnetic Frequency Changers, by L. L. Rozhanskii (translated from the Russian) discusses theory, layout, construction and design of devices based on non-linear inductance. Pp. 110. Price 35s.

Fundamentals of Microwave Electronics, by V. N. Shevchik (translated from the Russian). Broad general survey based on a series of lectures by the author at Sarator State University, of the interaction of electron streams with alternating electromagneic fields and of the practical devices which have emerged. Pp. 253. Price 70s.

Semiconductor Fundamentals, by A. H. Seidman and S. L. Marshall. A succinct course on semiconductor physics, transistor and diode (including tunnel diode) action and characteristics, and the application of these devices in amplifier, oscillator and logic circuits. Gives design formulæ and many worked examples. Pp. 278. John Wiley and Sons Ltd., Glen House, Stag Place, London, S.W.1.

The Physics of Magnetic Recording by C. D. Mee. A comprehensive survey of theories of the magnetic recording and reproducing processes and of the criteria for the specification of coating materials and tapes and their manufacture. Chapters are included on magnetic measurements and on experimental high-resolution recording systems. Features of this book are the emphasis on gap/coating relationships and the many diagrams of flux penetration and patterns of magnetization in depth. Pp. 270. North Holland Publishing Company, P.O. Box 103, Amsterdam. Price 60s., Fl. 30. or $8.40.

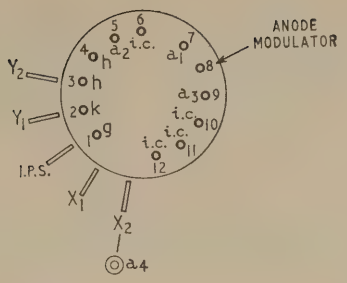
B.B.C. Engineering Training Manuals

Television Engineering. Vol. I. Fundamentals, camera tubes, television optics, electron optics. By S. W. Amos, B.Sc. (Hons.), A.M.I.E.E., D. C. Birkenshaw, M.B.E., M.A., M.I.E.E., and J. L. Bliss, M.I.E.E. Revised second edition now covers all line standards and deals more fully with image orthicon and vidicon tubes. Pp. 301. Price 45s.

B.B.C. Engineering Monograph No. 50. New Methods of Lens Testing and Measurement. Part I. A Photoelectric Lens Testing Bench, by W. N. Sprosen, M.A., and K. Hacking, B.Sc. Part II. A Method of Observing and Recording the Sources of Flare in a Lens. By K. Hacking, B.Sc., and J. C. Martin. Pp. 23. B.B.C. Publications, 35 Marylebone High Street, London, W.1. Price 5s.

Wireless World OSCILLOSCOPE

7.—CALIBRATION



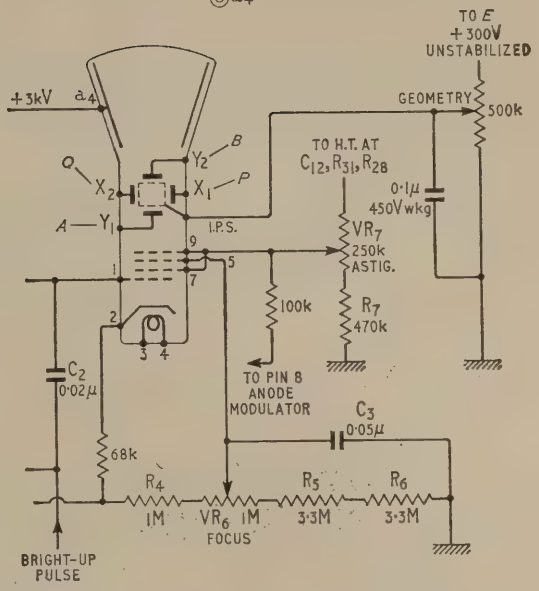


Fig. 3. Circuit modifications for Sylvania-Thorn SE3A tube. Tube base is obtained from Corr Fastener, Pinfold Lane, Stapleford, Notts.

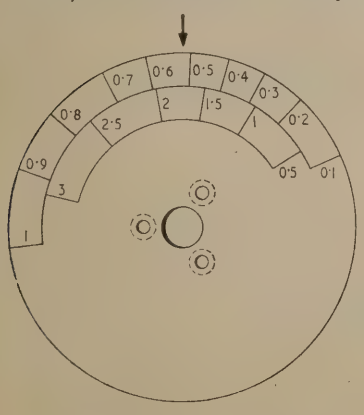
CONSTRUCTION of the oscilloscope is now completed, but before it can be used for voltage or time measurement, it must be calibrated. On this subject we must make the point that, while we will do our best in this series to keep to a minimum the equipment needed for test and calibration (for instance, the audio signal generator only required a meter and domestic radio and television), it is not possible to dispense with it entirely. We will try, as far as possible, to use test gear that we have already described, and the audio signal generator can be used for calibration of the oscilloscope.

One other point should be mentioned. When we publish a design it is as good as we can make it at a reasonable cost and in a reasonable development time. From this point on modifications occur to us, some are suggested, and price changes dictate others. In this way we describe the use of an alternative, cheaper tube and a rather more expensive, but more stable and efficient e.h.t. unit will come later.

Amplifier

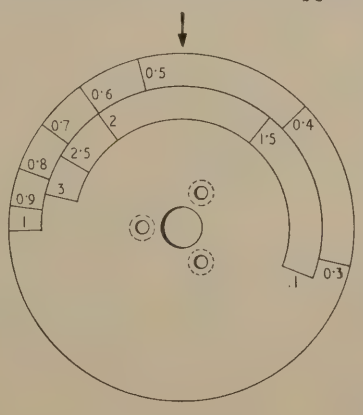
To return to the subject in hand, the *y* amplifier is probably the easiest unit to calibrate. A specimen dial is shown in Fig. 1. For this operation we need an audio signal generator with a calibrated output control (the "Wireless World" one will do very well, but so will many others). First set the amplifier "CAL/USE" switch to "USE," the attenuator to one of the "1" positions of the "1-3-10" sequence, and feed into the input socket a peak-to-peak signal of 100mV, 1V, 10V, etc. Set the *y* gain control to give a full-screen display. Switch to "CAL" and adjust the calibration waveform, by means of the "CAL VOLTAGE" dial, to fit between the same two cursor lines as the signal waveform. Mark on the dial "1" opposite the reference point. Switch back to "USE" and apply a signal of 90mV, 0.9V, 9V or any other 9 within the attenuator range. Switch to "CAL," adjusting the calibration voltage again and mark "0.9" opposite the reference point. Do this for all points from 0-1.

Repeat this procedure, on the other dial line, for signal inputs of 0-3 (30mV, 3V, 30V, etc). This completes calibration of the *y* amplifier.



Y DIAL

Fig. 1. Specimen y amplifier dial



X DIAL

Fig. 2. Typical time-base dial

Timebase

Calibration of timebase sweep times is a little complicated by the fact that the amplitude and therefore frequency are slightly affected by the presence of a sync. pulse.

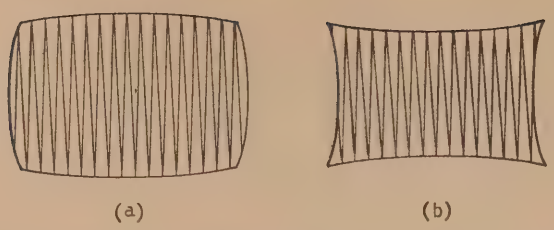


Fig. 4. Distortion caused by tube. Borrel distortion shown at (a), pincushion at (b). Correct by adjustment of interplate shield voltage (see text).

We will therefore assume for the purposes of calibration, that the timebase is unsynchronized. If, in this condition, the length of trace is set by the "X gain" control to fill the ten screen divisions, then calibration will remain correct for any range if, when synchronized, the gain control is left untouched. This is the penalty one pays for simplicity. In later units, calibration will be carried out in a different way, as sweep times will not be continuously variable. Provision has already been made for this in the present x amplifier.

Once again an audio oscillator is used. As, in our sweep generator, the flyback time is negligible compared with the sweep time, a cycle of the sweep waveform can be considered as being equal in duration to the sweep time, and a Lissajous method can be used. Two dial scales are used as seen in Fig. 2, corresponding to the sweep time 1-3 and 3-10 multiples. If the timebase capacitors used are cheap types with wide tolerances, it may be wise to perform the following process for each range, giving eight scales on the dial. For most applications, it will be sufficient to assume that each range is a multiple of the next but one.

Switch the trigger selector to one of the external positions. Set the "Time per Division" range switch on the timebase unit to 3μsec. Adjust the x gain control to give ten divisions of scan. Inject 33.3kc/s into the y amplifier, adjusting attenuator and gain controls to give a conveniently-sized display. Adjust the timebase dial to give one cycle of the signal on the screen. It will be very difficult

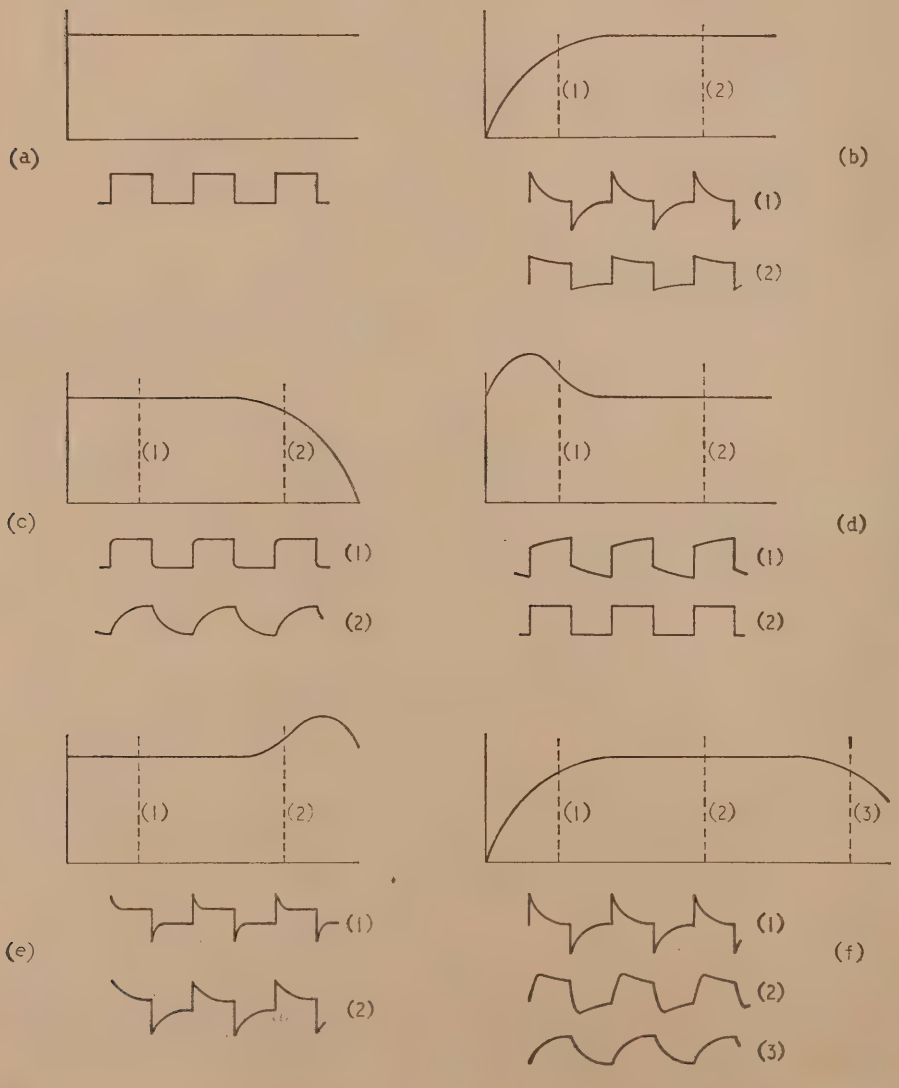


Fig. 5. Typical deformations of a square wave by amplifiers having different frequency characteristics. Square wave frequencies are shown as vertical lines on response curves.

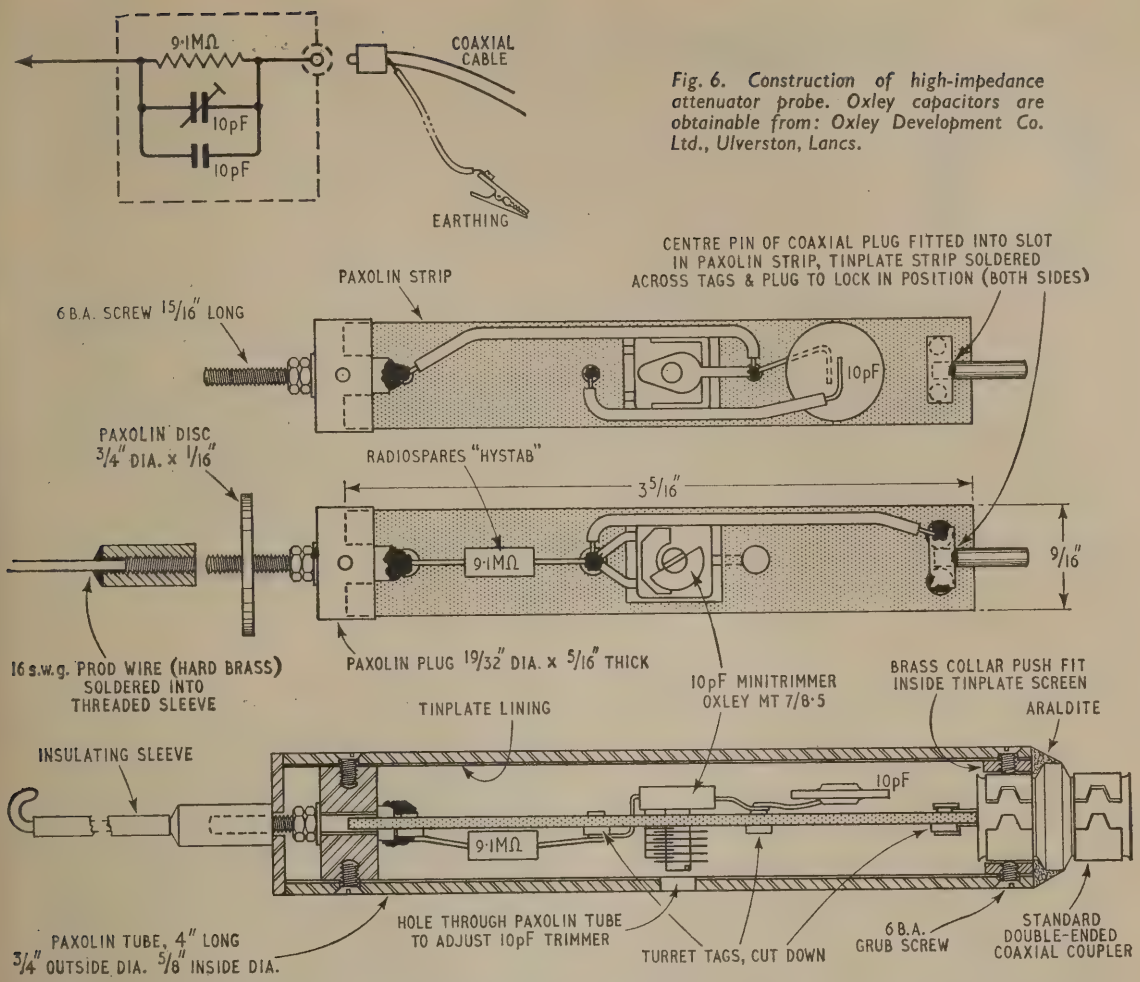

9·1MΩ
10pF
10pF
COAXIAL CABLE
EARTHING
CENTRE PIN OF COAXIAL PLUG FITTED INTO SLOT IN PAXOLIN STRIP, TINPLATE STRIP SOLDERED ACROSS TAGS & PLUG TO LOCK IN POSITION (BOTH SIDES)
PAXOLIN STRIP
6 B.A. SCREW 15/16" LONG
10pF
PAXOLIN DISC 3/4" DIA. x 1/16"
RADIOSPARES "HYSTAB"
3 5/16"
9·1MΩ
9/16"
16 s.w.g. PROD WIRE (HARD BRASS) SOLDERED INTO THREADED SLEEVE
PAXOLIN PLUG 19/32" DIA. x 5/16" THICK
10pF MINITRIMMER OXLEY MT 7/8·5
BRASS COLLAR PUSH FIT INSIDE TINPLATE SCREEN
ARALDITE
TINPLATE LINING
INSULATING SLEEVE
10pF
9·1MΩ
PAXOLIN TUBE, 4" LONG 3/4" OUTSIDE DIA. 5/8" INSIDE DIA.
HOLE THROUGH PAXOLIN TUBE TO ADJUST 10pF TRIMMER
TURRET TAGS, CUT DOWN
6 B.A. GRUB SCREW
STANDARD DOUBLE-ENDED COAXIAL COUPLER

Fig. 6. Construction of high-impedance attenuator probe. Oxley capacitors are obtainable from: Oxley Development Co. Ltd., Ulverston, Lancs.

to obtain a stationary pattern, but a very small movement of the dial will make the pattern change quickly, which means that, if it moves only slowly, the two frequencies are near enough equal. When a steady or slowly-moving pattern is seen, mark the dial with "3." Repeat this process for dial markings from "1" to "3" and from "3" to "10." The signal applied to the y input should be $1/10t$ Mc/s where t is the time per division, in microseconds, being calibrated. For instance, on the second range, 10μsec per division, suppose that point "6" is to be marked. The frequency needed is 1/60 Mc/s= 16.7kc/s. The highest and lowest input frequencies required are 100kc/s and 10c/s respectively.

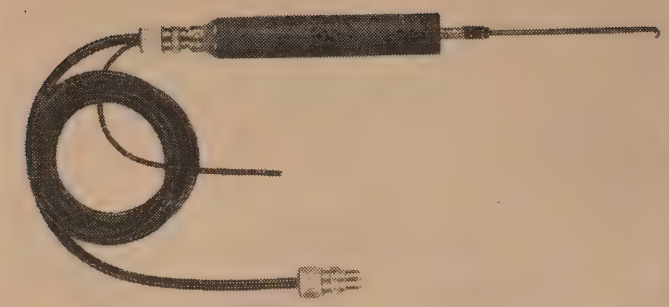
New Tube

As we mentioned earlier, many queries have been received on the subject of tube replacement, usually because of the cost of the DN7-78. Price changes since the oscilloscope was first published have led us to use a cheaper tube with roughly the same specification—the Sylvania-Thorn SE3A. Only slight modifications are needed for this tube, three of them being shown in Fig 3. The astigmatism control is now returned to h.t. at C_{12} and it was found that a geometry control was needed. This takes the form of a potentiometer across the h.t. line with the inter-plate shield of the tube taken to the wiper. This should not need frequent adjustment and is a preset control, or it can even be two fixed resistors. The wiper voltage should be adjusted until neither pincushion nor barrel distortion is shown on the screen. This is best displayed by feeding a high frequency to the y amplifier and running the timebase slowly, so that a raster is obtained. The display should almost fill the screen. A 68kΩ resistor should be inserted in the tube cathode circuit to prevent excessive beam current.

The Telcon Type SYLT3 Mu-metal screen should be used. The address of the tube makers is Thorn-A.E.I. Radio Valves and Tubes Ltd., Industrial C.R.T. Division, Millmarsh Lane, Brimsdown, Enfield, Middx. Telcon Metals are at Manor Road, Crawley, Sussex.

Uses

One of the main uses of the "No. 1" amplifier and timebase will be for audio testing. A quantitative frequency-response curve can be made by noting the output amplitude of an amplifier at different frequencies, but a quick, qualitative check is easily provided by using a square wave input at appropriate frequencies and examining the displayed output shape. In this context, one picture is worth two



High-impedance attenuator probe.

chapters of words, and Fig. 5 is therefore included.

Distortion measurement by oscilloscope is not easy. By simply gazing at an alleged sine wave, it is almost impossible to judge distortion of less than about 10 per cent, and less than 5 per cent is, to all practical purposes, invisible. Other methods must be used which would be out of place in this article, although we will possibly describe them later.

Frequency measurement by Lissajous figures has already been described in the time-base calibration, and this can be extended, although the time base is sufficiently accurate for most audio tests.

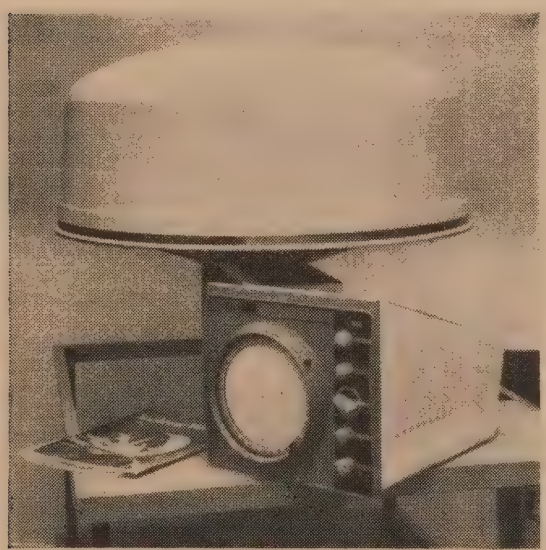
Probe

If a high-impedance source is to be examined, it may be found that the 1MΩ input impedance of the *y* amplifier is too low, and that the capacitance of a screened input cable is too high. For this reason, we have produced an attenuator probe which has an input impedance of 10MΩ in parallel with 10pF. It attenuates the signal by a factor of 10, and is therefore used on high-impedance, high-level signals. The trimmer is set up by looking at a square wave and adjusting the trimmer for no overshoot or rounding on the leading edge of the waveform. Construction is shown in Fig. 6.

YACHT RADAR

ALTHOUGH many compact and comparatively low-priced radars have been developed and marketed in recent months the majority of these have been for small coasters, or as second sets on ocean-going vessels. True there have also been mentions of yachts in the sales literature but implicitly these have been of the large luxury type.

A new radar (Model 1900) produced by Raytheon and distributed in the U.K. by Coastal Radio Ltd., sets



Radome and display unit of the Raytheon 1900 radar.

a new standard for compactness and low weight and opens up the wider field of small yachts and working boats.

Separate parabolic aerials, one for transmission and one for reception are mounted, together with their 3cm wavelength electronics and the rotation mechanism, inside a moulded one-piece radome 33in in diameter and 17in deep, weighing 43lb.

There are no waveguides and 50ft of video cable can be used between aerials and indicator units.

There are two other units, the display with 7in c.r.t. measuring 16 × 12 × 11in (weight 30lb) and power supply 16 × 9 × 7in (weight 15lb).

Range scales are provided for ½, 2, 6 and 12 miles (maximum range) and a resolution of 30 yards is claimed for the ½mile range.

Frequency is 9410 Mc/s (±50 Mc/s), peak power 3.5kW, pulse length 0.14μsec and p.r.f. 2000. Beam width (3dB points) is 3° horizontal and 27° vertical with side lobes <-21dB.

The price of the Raytheon Model 1900 is £770.

5WW 337 for further details.

Telemetering Television Transmitters

TO extend the coverage of the island's television service the Cyprus Broadcasting Corporation has installed two additional stations on mountains (Mt. Olympus and Sina Oros). These two stations, each comprising two vision and two sound transmitters with their common programme input equipment, are to be controlled and supervised from the main station at Nicosia which is about 40 miles from each of the two "satellites." Duplex v.h.f. radio links are employed for the telemetry system which is being installed by Pye Telecommunications Limited. The system provides information on 23 points at each station and each of these is tested every 1.15 seconds.

Twenty controls covering the running up, shutdown, and if necessary the changeover of transmitters and associated equipment can be carried out from the main station. If the radio telemetry link should fail the "satellite" transmitter would be automatically transferred to a time-switch mechanism. If, on the other hand, the programme radio link failed the remote transmitter can be switched to rebroadcast "off the air" the transmissions from the other station.

LETTERS TO THE EDITOR

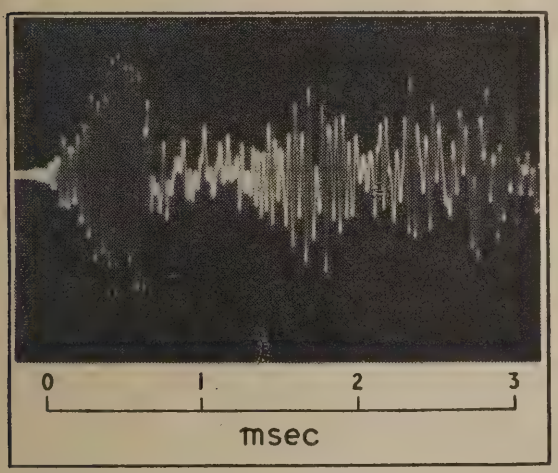
The Editor does not necessarily endorse opinions expressed by his correspondents

Hi-Fi by Numbers

I HAVE been reading with considerable interest the letter from Mr. C. C. V. Hodgson, the B.B.C. reply and the correlated editorial, all of which appeared in your January, 1964 issue.

As regards the bandwidth of 10 kc/s for long-distance music lines mentioned by the B.B.C., it would be interesting to see a response curve showing the sort of roll-off that actually occurs. It seems unlikely that there could be a sharp termination at 10 kc/s like cutting the top off a stick of celery; I assume there would still be a few leaves hanging on in the 10 to 15 kc/s region.*

This question of frequency range and quality is of never ending interest but the emphasis should, as you say, always be placed on quality. Even with a bandwidth of 10 kc/s the reproduction of speech is cleaner and music is brighter on f.m. than on a.m. where the bandwidth is probably 2 to 3 kc/s narrower. On the other hand, line distortion shows up sooner on the f.m. transmissions and I occasionally find it necessary (in Yorkshire) to change over to a.m. to avoid harshness, although this happens nowadays much less frequently than it did a few years ago. No doubt the quality of the lines has been improved and I suppose that still higher standards would be necessary with a bandwidth of 15 kc/s, otherwise complaints would be more numerous than compliments.



Oscillogram of random frequencies produced by cymbal, showing as many as 24 vibrations in one millisecond.

But how important is the 10-15 kc/s range in the reproduction of music? According to tests made by Snow, 14 out of 22 well known instruments require response up to 15 kc/s to avoid perceptible change in quality.

We have recently been making a few lab. tests at Wharfedale and we find that instruments such as the harp, Spanish guitar, harmonica and triangle reach 20 kc/s. The highest stepper seems to be the cymbal as it is possible to see quite strong vibrations at 24 kc/s in the oscillogram of Fig. 1.

Finally we come to the question: How important is the frequency range above 15 kc/s? I should be inclined to reply, not very, because few instruments are involved and the majority of adults hear very little at these very high frequencies. For my part, I should be happy to settle for the B.B.C. bandwidth of 10 kc/s because I suffer from presbyotia, due to anno Domini, eruditely described by "Free Grid" in the same *W.W.* January issue. I am stone deaf above 13 kc/s so, along with "Free Grid," I can enjoy a measure of immunity from attacks by shrieking sopranos.

Idle, Bradford, Yorks. G. A. BRIGGS
Wharfedale Wireless Works, Ltd.

*Do some people relish these excrescencies?—Ed.

IT was disappointing to note your reactionary and rather dusty opinion regarding the present broadcast frequency range put out on v.h.f. by the B.B.C.

The general tenor of your remarks suggests the Victorian father's "brush-off" to his children, that they are lucky to enjoy things as they are and should not be "greedy" in desiring an improvement.

It should be pointed out that an art is seldom furthered by the common denominator but rather that the "few" whom you appear to push on one side, are the real spearhead of advance.

The modern l.p. record has pushed on leaving radio a second best and also added stereo for good measure.

It is obvious that the backwardness of broadcast quality is not due to the engineers but to the politicians and it is all too easy to see that the engineers are being pushed up another street, i.e., Television Alley. Note how "sound" is now in very small type in the *Radio Times* and the high-powered advertising for the new TV channel all too strident.

In other words the politicians have chosen the painted harlot of colour TV as the end, rather than the twin virgins of pure stereo sound.

There are more Mr. Hodgsons than you imagine.

Welwyn Garden City. J. D. A. BOYD

[The small print could be the result of the longer hours and the greater variety of sound broadcasting?—Ed.]

I HAVE been most impressed by the B.B.C.'s spirited defence (January 1964 issue) of their policy of using landlines of only 7.5kc/s bandwidth to distribute the v.h.f. service to regional transmitters.

The money saved in G.P.O. rentals will no doubt help to finance the new programmes for BBC-2. Let us hope that when this achieves national distribution the same policy will be applied and the link bandwidth limited to an economic 3Mc/s.

Brentwood. JOHN NEATE

I READ with interest your comments on Mr. Hodgson's complaints regarding the restricted audio frequency band transmitted by the B.B.C.

For more than thirty-five years I have missed no opportunity of listening with careful attention to music, both live and reproduced. I am over fifty and my cut-off has descended from 17,000 to 12,500 c/s and I am not as discriminating as I used to be. This does not make me any less sensitive to distortion and this is the limiting factor in sound reproduction, and not frequency response.

There is no practical complete system of sound reproduction in which distortion does not become increasingly apparent as the reproduced bandwidth rises above about

7000 c/s. Only a handful of people have radio receivers in which the discriminator stage alone does not contribute sufficient distortion to make this statement obviously true.

There is no point in the B.B.C. spending large sums of money on raising the pass band until the overall transmitting system is capable of a much better fidelity than is feasible at present.

Until then Mr. Hodgson might be more content if he balanced his low- and high-frequency cut-offs, as recommended by Olson.

Whitby. E. W. ROYSTON

WHATEVER one's views on this matter, Mr. Hodgson's letter and your Editorial make welcome comment. I move, however, that the last paragraph of your leader be stricken from the records; if one must seek analogy with motor cars, surely Mr. Hodgson is pleading for greater refinement in everyday travel—from which most motorists should benefit most of the time.

The truth of many of your own comments is surely attested by the recent history of disc recording. Some years ago the disc recording companies threw open the window so wide that the amount of aural dirt admitted became distressing; we would have been happier with less "top" while enjoying the concurrent improvement in other directions that you mention. But the recording technicians proceeded to clear up the dirt, and in my opinion with a quite remarkable degree of success; whereas after reading Mr. Turner's letter one has the unhappy impression that the B.B.C. would have been only too content to close the window. I find it difficult to be certain that the greater satisfaction I now get from records as compared with f.m. at its best is due entirely to an extended top range; however, on a basis of some 35 years' aural—and often penal—servitude to domestic reproduction I maintain that those extra few thousand cycles *are* of more importance than you seem prepared to admit.

Even so, the issue at the moment must affect very, very few listeners. As to the future, I can see no evidence of this tiny minority increasing. Firms enter the quality market and fade away, and I judge Mr. Hodgson's opening paragraph overstates his case.

In spite of this, I find myself entirely on his side. In the first place, the struggle for the best is always worthwhile; secondly, the B.B.C. is avowedly wedded to the welfare of the estimable minority, as witness, for example, the amount of recondite music provided on the Third Programme. If Mr. Turner is really correct in presenting the problem largely as one of expense, let me assure him that the great majority of us would gladly waive the privilege of listening to the organ music of Clérambault if the saving would provide an extra couple of thousand cycles on our Mozart.

I think most of that small but important minority, the readers of *W.W.*, will share my opinion. Let us hope there is space in your correspondence columns to ventilate the subject.

Felixstowe. L. E. SMITH

IS your correspondent Mr. Hodgson sure that he can hear audio frequencies up to 15 kc/s as he appears to suggest? I used to think that my hearing extended up to 20 kc/s or so; however, recently at the Radio Communications Exhibition at the Seymour Hall I tested my acoustic response with the device provided and was surprised to find that my hearing cut off at 12 kc/s. As a matter of interest I am aged 39 years.

In 1939 the H.M.V. £100 Radio Gram had a band width of 8 kc/s and the manufacturers stated in their Service Manual that in the case of this high-quality model "that too much dirt had not been allowed to blow through the window." As the Editor correctly states, frequency response is not the only criterion in obtaining good sound reproduction and in my opinion the advantages of stereophony and resulting three-dimensional sound reproduction can more than make up for a frequency response which is not ideal, as was made evident by a stereophonic demonstration at the Seymour Hall.

The B.B.C. nowadays broadcasts a few stereophonic transmissions. Therefore, be of good cheer, Hi-Fi enthusiasts, because better things may yet come even with a limited frequency response.

Bromley. W. E. GARDNER

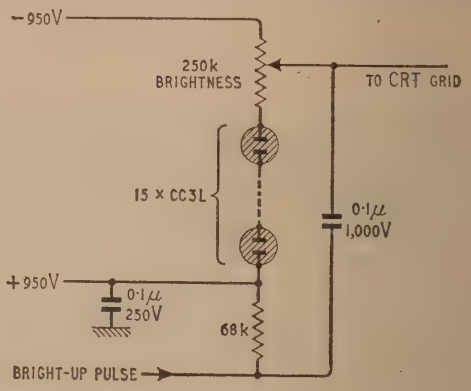
W.W. Oscilloscope

"WE have built a *Wireless World* oscilloscope which works well and promises to be a very useful instrument. As first built, it had for us a serious fault, which we have ameliorated by a simple modification, which we hope will interest other constructors.

Since the e.h.t. power supply unit is fed from the unstabilized h.t. supply, a change in the mains voltage affects the output of the floating c.r.t. grid bias supply, but does not similarly affect the neon-tube-stabilized e.h.t. negative supply. Hence the c.r.t. grid-cathode voltage depends on mains voltage, and the dependency is such that a 2-volt increase in mains voltage extinguishes the trace altogether.

Possibly in the *Wireless World* laboratories the mains are pretty steady and the effect is unimportant. In Cambridge, however, laboratory voltage is rather variable, and the effect is quite unacceptable.

We have stabilized the floating c.r.t. grid supply with



a second string of neons, 15 in all, as in the accompanying circuit.

The oscilloscope is now usable on any voltage between 185 and 230 (transformer on 200-210 volt tap) with small adjustments in brightness and focus.

Many thanks for this sponsored design. Let us see more of them!

P. E. K. DONALDSON
D. P. GRIFFIN
Physiological Laboratory, Cambridge

[Mr. Donaldson and his colleague have a valid point, although such extreme sensitivity to mains variations has not been our experience. However, we have in mind a new e.h.t. unit, occasioned by the use of a cheaper tube, which uses a valve stabilizer and does not exhibit this characteristic. —Ed.]

Colour Television Systems

IT is interesting to hear (Jan., p. 40) more of the background to the N.T.S.C. system from Mr. Macwhirter. There is evidence that the onset of crawling bars or "Venetian blinds" on simple PAL receivers with differential phase errors in the transmission path is relatively sudden, whereas an N.T.S.C. receiver will show progressive degradation. There may be an equivalent onset of flicker with field-rate switching which is objectionable on 50-field systems, but which was tolerable at that time on the 60-field system. Field-rate switching was no doubt adopted because at that time (1952-53) no practical one-

line delay was available. A clamp pulse width of 1.4 μsec seems rather narrow and may make for a rather inefficient clamp, particularly with single-transistor clamp circuits, which are becoming increasingly used. I, too, would be interested to hear further comment on this point.

One must agree to a point with Mr. Macwhirter's final remark, although the absence of a tolerance on linear phase error and a far wider tolerance on differential gain and phase would have simplified instrumentation.

I would like to add two final points on the SECAM system which may have arisen since my article, published in the September 1963 issue, was written.

The first concerns the delay lines. These have now been manufactured from a grade of mild steel with adequate performance in terms of thermal stability and spurious responses for the SECAM system. The cost is estimated at 15 NF (approx. 22s) by the C.S.F.

The second point concerns the final cost of a SECAM receiver. C.F.T. have completed a design study for a complete receiver, and the cost of this receiver has been computed by the F.N.I.E., the French counterpart of B.R.E.M.A. They have put the cost at no more than, and probably less than, an N.T.S.C. receiver of equivalent performance.

Teddington. M. COX
A.B.C. Television, Ltd.

Generating Low Frequencies

THE letter by M. D. Armitage in the December issue of *Wireless World* commenting on the problems of producing very low frequencies prompts me to propose what I believe to be a novel approach.

The rotor of an induction motor has a current induced in it at slip frequency, i.e. a frequency which is mains frequency multiplied by the slip expressed as a fraction. The slip is, of course, dependant on the running conditions, e.g. the load on the motor.

Hence, if an induction motor drives a variable load, e.g. a magnetic brake, low frequencies from some 1% of mains (0.5 c/s) to full mains frequency (when the rotor is stationary) exist in the rotor.

The low frequencies, in the form of a small current, can be extracted from a slip-ring motor by connecting a suitable resistance between a pair of slip rings. In a squirrel cage motor, a low-frequency voltage usually exists between the two ends of the shaft.

An alternative approach is to use an induction motor to drive an alternator and to subtract the output of the alternator from a suitable mains voltage. This technique, however, requires voltage balancing circuits.

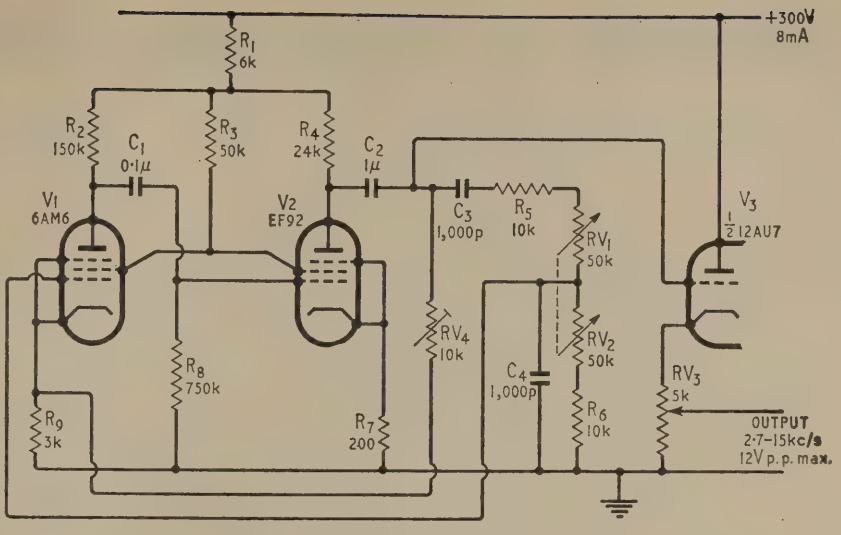
I would be interested to know whether this principle has ever been used for the generation of low frequencies.

Esher. ARTHUR GARRATT

Bridge Oscillator

PERHAPS your readers would be interested in a novel Wien bridge oscillator recently designed by me, which has certain rather unusual features.

The circuit at first looks fairly conventional, the unusual features being the common screen load R_3 and the fact that a preset potentiometer RV_4 takes the place of the conventional thermistor. Feedback stabilization is obtained via the common screen connection, though how it works is a mystery to me. The sine wave across R_3 is by far the largest in the circuit.



Unconventional bridge oscillator (J. P. Crean).

The waveform at V_1 anode resembles a cycloid and may in fact be an electronic analogue of the involute curve; the result of one circle rolling about another. The circles in this case being the grid and screen waveforms.

The cycloidal waveform from V_1 anode is corrected to a sine wave by the variable-mu characteristic of V_2.

The variation in output load provided by the Wien network is a necessary part of the circuit since the provision of a cathode follower in the feedback loop causes distortion.

If the resistor R_1 is omitted l.f. instability tends to occur when frequency is changed. Other circuits on these lines have been constructed by me, including one covering 150 c/s to 50 kc/s in two ranges.

From the stability point of view, variable bridge capacitors, and fixed resistors are preferable.

Marlborough. J. P. CREAN

INFORMATION SERVICE FOR PROFESSIONAL READERS

To expedite requests for further information on products appearing in the editorial and advertisement pages of *Wireless World* each month, a sheet of reader service cards is included in this issue. The cards will be found between advertisement pages 40 and 43.

We invite readers to make use of these cards for all inquiries dealing with specific products. Many editorial items and all advertisements are coded with a number, prefixed by 5WW, and it is then necessary only to enter the number(s) on the card.

Readers will appreciate the advantage of being able to fold out the sheet of cards, enabling them to make entries while studying the editorial and advertisement pages.

Postage is free in the U.K., but cards must be stamped if posted overseas. This service will enable professional readers to obtain the additional information they require quickly and easily.

Elements of Transistor Pulse Circuits

2.—LINEAR PULSE AMPLIFIERS

By T. D. TOWERS,* M.B.E.

IN pulse work, an obvious need is for a circuit to amplify a pulse with as little change of shape as possible, i.e. a linear pulse amplifier. As it happens, this also turns out to be what most engineers know as either a video, wide-band, broad-band or base-band amplifier. What you call it depends on what field you work in, but it is basically an amplifier whose passband extends from a low audio frequency to an upper frequency many times the lower limit frequency. The high frequency limit is usually not less than 100kc/s. It may in special cases extend out to many hundreds of megacycles.

Transistors are smaller and more efficient than valves and have tended to replace them in general-purpose linear pulse amplifiers. Fortunately, most of the wide-band amplifier techniques developed for valves carry over into transistors. We will deal only briefly with these established techniques, leaving it to the interested reader to consult a standard text-book such as "Pulse and Digital Circuits," by J. Millman and H. Taub (McGraw-Hill). Special problems raised by the use of transistors we will examine more comprehensively.

General Design Problems

There are two ways you can approach linear pulse amplifier design. The first is to consider the response of the amplifier to a square-wave input and specify the performance in terms of (a) pulse gain, (b) pulse rise-time, and (c) pulse droop. The second is to examine its response to a continuous sine-wave input, and specify performance by (a) midband gain, (b) upper and (c) lower half-power bandwidth limits. It can be shown that the two approaches lead to the same practical results and we will generally adopt the more familiar continuous sine-wave approach.

Interstage Coupling:—Interstage coupling is the first problem. In theory, any of the three conventional methods—RC, direct or transformer coupling—is possible. In practice, linear pulse amplifiers are almost always RC-coupled. Direct or d.c. coupling brings in such problems of drift and of setting up bias voltage levels, that it is used only where the amplifier is specially required to operate down to zero or near-zero frequency.

Transformer coupling, too, raises difficult problems, mostly in the design of the transformer itself. With ferrite cores, a 30c/s-5Mc/s bandwidth is feasible. Bandwidths up to 200Mc/s have been produced experimentally with transformers, but, with these, optimum interstage matching is not usually possible due to the limited number of wire turns. Recent developments in wide-band transformer-coupled amplifiers employing transmission-line-type winding techniques have made possible bandwidths out to 1Gc/s at the high-frequency end, but poor low-frequency response restricts their use in linear pulse amplifiers. Quite apart from the design difficulties, transformer coupling is relatively the most expensive coupling method.

Because of all this, we will confine ourselves to the design of RC-coupled pulse amplifiers only.

Transistors in Linear Pulse Amplifiers:—The transistor is normally considered as a current, rather than a voltage, amplifier, and the design of transistor linear pulse amplifiers usually works in terms of current gain. This contrasts with valve designs which are usually worked in terms of voltage gain.

In a linear pulse amplifier, the transistor could be used in any of the three basic configurations shown in Fig. 22: (a) common-base; (b) common-emitter, and (c) common-collector. However, the common-emitter connection is normally used, because with

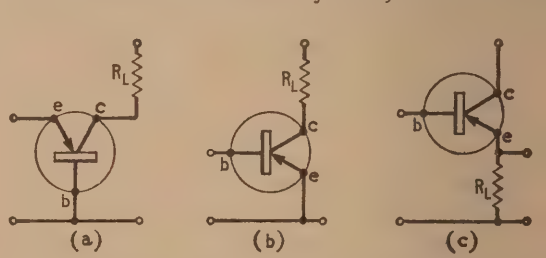


Fig. 22. Transistor configurations. (a) common-base, (b) common-emitter, (c) common-collector.

RC coupling it can provide both voltage and current gain. Without a matching transformer the common-base arrangement has no current gain and the common-collector no voltage gain. The common-collector and common-base connections will mainly be found used only as terminal stages. The common-collector may start or end a chain to give high input resistance or low output resistance. The common-base may be used as a final stage where high voltage is required.

Pulse Characteristics:—As noted earlier, one way of specifying the small-signal performance of a linear pulse amplifier is in terms of pulse properties such as rise and fall times. Fig. 23 illustrates the terms used for a typical pulse waveform. AXYS represents the input pulse, and ABCDEFGH the amplified output pulse. The *pulse gain* is the ratio of RD, the output pulse peak amplitude, to AX, the input amplitude. The *rise time*, T_R, is the distance PQ along the time axis where PB represents 10% and QC 90% of the peak amplitude, RD, i.e. the time for the output pulse to rise from 10% to

* Newmarket Transistors Ltd.

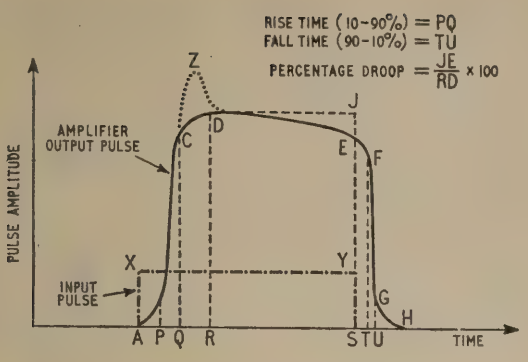


Fig. 23. Pulse response characteristics.

90% of the peak. At the end of the input pulse, S, the output pulse will have "drooped" to the point E, and the *pulse droop* is the fall JE expressed as a percentage of the peak amplitude, RD. Finally the *fall time*, T_F, is the distance TU along the time axis corresponding to the fall from point F (10% below point E) to point G (90% below point E). In the diagram, we have also shown in a "dotted" curve, CZD, the "overshoot" that sometimes occurs when inductive compensation circuits are used. Here the vertical distance from D to Z, expressed as a percentage of RD, is a measure of the overshoot.

As we are considering small-signal operation, the transistor operates only in its active region, neither cutting off nor bottoming. The droop of the pulse top then depends on the relation of the pulse length to the time constants of the coupling and by-pass RC networks. Also, provided the droop is small (as is usually the case), the fall time can be taken as equal to the rise time.

The pulse performance is then normally specified by (a) gain, (b) rise time, and (c) percentage droop. (For the present we are disregarding overshoot.)

It can be shown that to a good approximation, the response to a train of square waves is related to continuous response characteristics as follows:

Pulse gain = midband gain .. .. (1)
Pulse rise (and fall) time = $1/3f_B$ .. .. (2)
Percentage pulse droop = $300f_o/f$ .. .. (3)

where f_B = amplifier continuous response upper 3dB turnover frequency,
f_o = lower 3dB turnover frequency, and
f = repetition frequency of input square wave.

Frequency Characteristics:—In a linear pulse amplifier, the primary circuit requirement is to keep the gain constant over the amplifier design bandwidth. For various reasons, apparent later, gain tends to fall off at both low and high frequencies.

At low frequencies, the transistors themselves present few problems. Their parameters are real and constant in this region. Input and output resistances can be easily calculated from simple formulae and conventional audio-frequency design techniques used. Low-frequency response falls off mostly due to the limitations of finite coupling and bypass capacitors. The main difference from valve designs will be found in the values of the coupling capacitors. Transistor input impedance being low compared with a valve, coupling capacitors generally come out orders of magnitude higher. The actual physical size of the capacitors does not increase, however, because the transistor works at a much lower voltage level than a valve and capacitors with lower voltage ratings can be used.

At high frequencies, amplifier response falls off mainly due to the fall off in transistor gain, and to transistor internal capacitances or circuit external stray capacitances shunting the signal or introducing feedback.

In the transistor itself, the common-emitter short-circuit current gain falls off to unity at a characteristic frequency f_1 (practically the same as the frequency f_T sometimes quoted instead by manufacturers). This behaviour is illustrated in Fig. 24. It will be seen that above f_{hfe} (the frequency at which h_{fe} is 3dB down on its low frequency value, h_{fe0}) the transistor current gain follows the approximate law:

h_{fe} (at frequency f) $= f_T/f$ .. .. (4)

and that f_{hfe} is therefore given by

$f_{hfe} = f_T/h_{fe0}$ .. .. (5)

In this context, we should note a concept often used in amplifier design—the "gain-bandwidth" product, GB. This is the product of the midband gain and the 3dB upper frequency limit. For the transistor itself,

$GB = h_{fe0} \times f_{hfe} = h_{fe0} \times (f_T/h_{fe0}) = f_T$ .. (6)

This gain-bandwidth product, f_T, is often used as a figure of merit for a transistor to be used in a linear

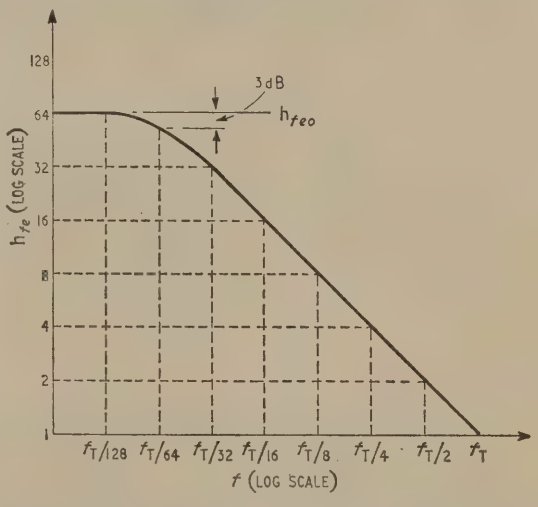


Fig. 24. Variations of common-emitter current gain (h_{fe}) with frequency.

pulse amplifier. Clearly, the higher f_T, the less the current gain fall-off will restrict the upper frequency response of the amplifier.

Equivalent Circuits:—There are several equivalent circuit models that could be used for considering transistor high-frequency performance in a linear pulse amplifier. At the approach level adopted here, the simplified hybrid-pi circuit developed in Fig. 25 has some advantages. Fig. 25(a) shows a simple RC-coupled common-emitter stage. At the high-frequency end of the bandwidth we can consider the coupling and bypass capacitors, C_1, C_2, C_3, as a.c. short circuits. Also we can lump the source resistance, R_1, and the two base-bias resistors,

R_2, R_3, into one equivalent resistance, R_s. Finally we can lump the collector resistor, R_4, and the load resistor, R_6, into an equivalent resistance, R_L. Using the full hybrid-pi equivalent circuit, this leads to the arrangement of Fig. 25(b), where each of the elements is independent of frequency.

In linear pulse amplifiers, R_L is usually small compared with $r_{b'c}$ and r_{ce}, and C_T is relatively small compared with $C_{b'e}$. Ignoring these high-impedance items, we get the simplified hybrid-pi circuit of Fig. 25(c). As the load resistance is usually small, $C_{b'c}$ does not shunt it appreciably. Moreover, the direct transmission through $C_{b'c}$ is small compared with the output of the current generator $g_m v_{b'e}$, and may be ignored on the output side. Because of the Miller effect, the effective capacitance looking into $C_{b'c}$ towards the load can be shown to be approximately $g_m R_L C_{b'c}$ (which is effectively in parallel with $C_{b'e}$). Finally, in practical circuits, $r_{bb'}$ is usually small compared with R_s and $r_{b'e}$, so that the equivalent circuit can be further simplified to Fig. 25(d), where $C = C_{b'e} + g_m R_L C_{b'c}$.

Looking at the equivalent circuit of Fig. 25(d), we can see that the voltage, $v_{b'e}$, across $r_{b'e}$ will fall off at high frequencies due to the shunting effect of C. This means that the corresponding amplifier output current, $g_m v_{b'e}$, also falls off at high frequency.

Amplifier Gain and Bandwidth Without Compensation:—For the simplified circuit of Fig. 25(d), which has no frequency compensation circuit included, the current gain is given by

$$A_i = \frac{i_o}{i_s} = \frac{g_m v_{b'e}}{v_{b'e}/(R_s//r_{b'e}//X_c)}$$

$$= g_m(R_s//r_{b'e}//X_c) \quad .. \quad .. \quad (7)$$

At low (midband) frequencies, X_c, the reactance of C, can be disregarded as very high, and the midband amplifier current gain is then given by

$$A_{io} = g_m(R_s//r_{b'e}) = g_m \times \frac{R_s r_{b'e}}{R_s + r_{b'e}} \quad .. \quad (8)$$

As frequency rises, the current gain A_i in equation (7) falls to a 3dB-down point at a frequency given by

$$f_B = \frac{1}{2\pi C(R_s//r_{b'e})} = \frac{R_s + r_{b'e}}{2\pi C R_s r_{b'e}} \quad .. \quad .. \quad (9)$$

From (8) and (9), the amplifier gain-bandwidth product is given by

$$GB = A_{io} f_B = \frac{g_m}{2\pi C} = \frac{g_m}{2\pi(C_{b'e} + g_m R_L C_{b'c})} \quad (10)$$

If in Fig. 25(d) we make R_s very large and R_L very small, we get the circuit for measuring the short-circuit current gain of the transistor itself. From equation (8) this gives

$$h_{fe0} = g_m r_{b'e} \quad .. \quad .. \quad .. \quad .. \quad (11)$$

and, from (9)

$$f_{hfe} = \frac{1}{2\pi C_{b'e} r_{b'e}} \quad .. \quad .. \quad .. \quad .. \quad (12)$$

Thus the transistor gain-bandwidth product referred to in (6) is given by

$$f_T = h_{fe0} \times f_{hfe} = \frac{g_m}{2\pi C_{b'e}} \quad .. \quad .. \quad (13)$$

Typical Uncompensated Linear Pulse Amplifier Stage:—To put real values to all this, let us consider a modern germanium alloy r.f. transistor, for which typically, $g_m = 39 \times 10^{-3}$ mho, $r_{b'e} = 2{,}500$ ohms, $C_{b'e} = 530$ pF, and $C_{b'c} = 10$pF. Substituting these values in (11), (12) and (13) we get $h_{fe0} = 100$, $f_{hfe} = 125$kc/s, and $f_T = 12.5$Mc/s. (Note that in alloy r.f. transistors, it can be shown that $f_{\alpha 0} = 1.2 f_T$, and we can thus derive the more familiar $f_{\alpha 0} = 15$Mc/s.).

If we now take a typical source resistance $R_s = 1{,}000$ ohms and a typical load resistance $R_L = 800$ ohms, and substitute these values in (8), (9) and (10), we get achievable characteristics of an actual single-stage uncompensated linear pulse amplifier as follows: Midband current gain = 28, 3dB bandwidth = 280kc/s and gain—bandwidth product = 7.8Mc/s. In terms of pulse response,

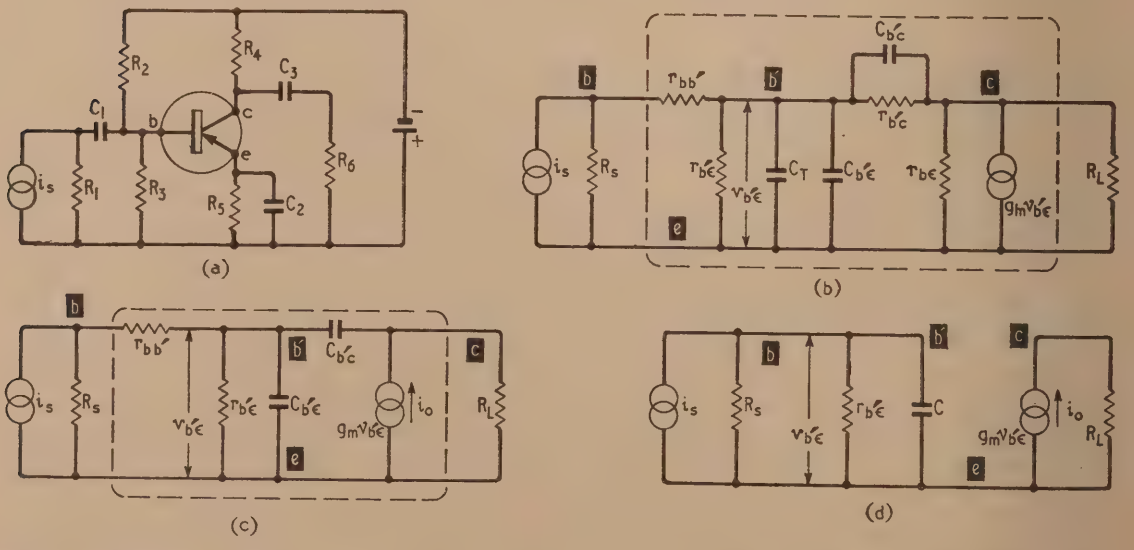


Fig. 25. Derivation of simplified equivalent circuit for high-frequency linear pulse amplifier, showing (a) actual common-emitter amplifier, (b) full hybrid-pi equivalent circuit, (c) partially-simplified equivalent circuit and (d) fully-simplified equivalent circuit.

this gives from (1) and (2) earlier, a peak pulse gain of 28 and a pulse rise (and fall) time of 1.2μS.

Collector Capacitance Effect:—In all the above, we have ignored the possible shunting of R_L by the collector capacitance. That this is justified we can see as follows: It can be shown that the collector-emitter capacitance is approximately given by $A_i \times C_{b'c}$. This shunts the load R_L, and the half-power frequency cut off of the combination in the numerical example given is:

$$f_c = \frac{1}{2\pi R_L(A_i C_{b'c})} = 710\text{kc/s.} \quad .. \quad .. \quad (14)$$

which is well beyond the 280kc/s. bandwidth of the amplifier arrived at above, when we ignored the shunting of R_L.

High-frequency Compensation

Four main techniques are used to extend the high-frequency response of linear pulse amplifiers: (1) negative feedback, (2) shunt inductance peaking, (3) series inductance peaking and (4) positive feedback

Negative Feedback H.-f. Compensation:—Simple negative feedback can be used in two ways as shown in Fig. 26. In the first case, Fig. 26(a), the unbypassed emitter resistor R_E, lowers the mid-band gain and pushes out the bandwidth limit, because the gain-bandwidth product is not much affected. It can be shown that the method is effective for R_E in the range:

$$R_s/h_{fe0} < R_E < R_s \quad .. \quad .. \quad .. \quad (15)$$

Approximate formulae for the compensated amplifier current gain and bandwidth are then:

$$A_{i0(F)} = \frac{A_{i0}}{1 + kh_{fe0}} \quad .. \quad .. \quad .. \quad (16)$$

and

$$f_{B(F)} = f_B\left(1 + \frac{kh_{fe0}}{1+k}\right) \quad .. \quad .. \quad (17)$$

where $k = R_E/R_s$.

In the typical numerical example given earlier, we had $A_{i0} = 28$, $f_B = 280$kc/s, $R_s = 1{,}000$ ohms and $h_{fe0} = 100$. If we now take $k = 1/100$, this gives $R_E = 10$ ohms, and we find that with feedback A_{i0} drops to 14 and f_B widens to 560kc/s.

A second method of applying simple negative feedback for gain-bandwidth trading is shown in Fig. 26(b) where feedback is from collector to base via the resistor R_F. It can be shown that this method is effective for R_F in the range

$$R_L < R_F < h_{fe0}R_L \quad .. \quad .. \quad .. \quad (18)$$

However the technique is of limited application for very wide bandwidths because the feedback resistor R_F eventually becomes so low that it materially loads both input and output circuits with a consequent loss of gain-bandwidth product.

The two simple negative feedback circuits of Fig. 26, can be modified for high-frequency peaking by introducing frequency conscious elements in the feedback path as shown in Fig. 27. Shunting of the emitter resistor by a small capacitor C_E as in Fig. 27(a) reduces the feedback at high frequency and thus increases the amplifier high-frequency gain. The value of C_E is often selected initially so that its reactance at f_{hfe} is equal to R_E, i.e.

$$C_E = 1/(2\pi f_{hfe}R_E) \quad .. \quad .. \quad .. \quad (19)$$

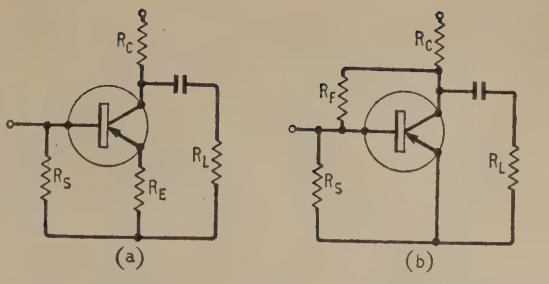


Fig. 26. H.-f. compensation by resistive negative feedback using (a) unbypassed emitter resistor and (b) collector-base feedback resistor.

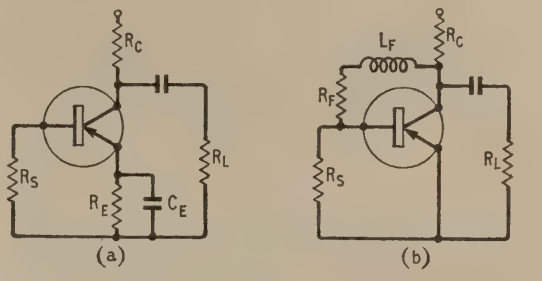


Fig. 27. High-frequency peaking by selective negative feedback, derived by (a) shunting emitter resistor by small capacitor and (b) inserting small inductance in series with feedback resistor.

With this as a starting value, C_E can be adjusted experimentally for the desired results.

The simple collector-base feedback of Fig. 26(b) can also be modified for high-frequency peaking by padding out the feedback resistor R_F with a series inductor or L_F as shown in Fig. 27(b). This inductor tends to reduce the effect of the feedback resistor R_F at high frequencies and thus extends the bandwidth. It can be shown that an approximate value for this inductor is:

$$L_F = R_F\frac{(1+R_F/R_L)}{2\pi f_T} \quad .. \quad .. \quad .. \quad (20)$$

Shunt-inductance H.-f. Compensation:—Shunt-inductance peaking can take several forms as illustrated in Fig. 28. The basic arrangement is an inductive impedance in parallel with the load, R_L, as in Fig. 28(a). Signal current is drawn off from the load through R and L in series. At low frequencies, the reactance X_L of L is low and the current diverted from the load is $R_L/(R + R_L)$ of the total available. At high frequencies, X_L increases and the current diverted from the load is reduced; i.e. the current into the load increases, compensating for the fall-off occurring otherwise.

In practical circuits, the shunt compensation is often achieved by padding out the collector resistor, R_c as shown in Fig. 28 (b). Although the value of L is usually set by " cut and try " methods, a useful starting point is to select L so that its reactance at the transistor common-emitter cut-off frequency, f_{hfe}, is equal to R_c, i.e.

$$L = R_c/(2\pi f_{hfe}) \quad .. \quad .. \quad .. \quad .. \quad (21)$$

The value of L to be expected in this case for the typical alloy r.f. transistor described earlier with

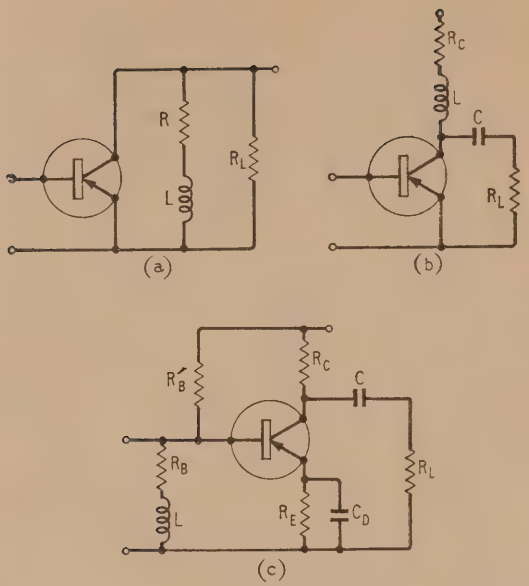


Fig. 28. Shunt high-frequency peaking circuits. At (a) is shown load-resistor padding, (b) padding of collector-load resistor and at (c) base-bias-resistor padding.

f_T = 12.5 Mc/s, h_{fe_0} = 100 and R_c = 1,500 ohms is then about 2mH.

The compensating inductor may be inserted in some other parallel network such as the base-bias potentiometer as illustrated in Fig. 28 (c). Here the same starting rule of thumb—making the reactance of L at f_{hfe} equal to R_B—can be used.

Shunt peaking is useful for compensating the current-gain fall-off of the transistor, but another method, series peaking, is usually adopted for dealing with signal shunting by the transistor output capacitance.

Series-inductance H.-f. Compensation:—Series inductance peaking is illustrated in its basic form in Fig. 29, and consists of inserting an inductor L in series with the transistor output. This inductor is approximately chosen initially to resonate with the collector output capacitance, $A_{io} \times C_{b'e}$, at the collector cut-off frequency:

$$f_0 = \frac{1}{2\pi A_{io} R_L C_{b'e}} \quad .. \quad .. \quad .. \quad (22)$$

It is then adjusted by cut-and-try methods. The practical circuit takes the form of Fig 29 (b) where

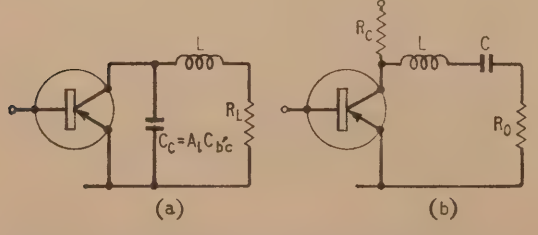


Fig. 29. Series-inductance high-frequency peaking, showing the basic circuit (a) and at (b) the practical circuit.

the effective load resistance is R_c and R_0 in parallel, and the large coupling capacitor C has such a low reactance that it can be ignored in the calculations. The optimum inductance value is difficult to compute because of the many variables involved, but in practice, designers often start from the empirical assumption that its reactance at the cut-off frequency of the unpeaked amplifier is equal to the transistor short-circuit input impedance at that frequency (usually obtainable from the manufacturer's data sheet).

Other H.-f. Compensation Techniques:—Positive feedback at high frequency is sometimes introduced by design to push out the upper frequency limit of the amplifier. This should be done with caution, because spreads of transistor characteristics can easily lead to instability.

Finally, it can be shown that the gain-bandwidth product of an uncompensated transistor wide-band amplifier is relatively independent of the emitter bias current, I_e. However, the transistor gain varies directly with I_e, so that it is possible to trade gain and bandwidth by varying I_e. This method has the disadvantage that the gain-bandwidth can vary widely between units because of the spread of transistor gain.

We have been concentrating on the transistor aspects of high-frequency compensation, but the reader is reminded that the valve technique of gain-bandwidth trading by varying interstage resistance loading is applicable also to transistors. The only limitation is that the resultant interstage shunt resistance R_s must lie between $r_{bb'}$ and $r_{b'e}$.

Another point not to be forgotten is that the overall amplifier gain must remain stable, i.e. not break into oscillation. Rigorous theoretical examination of possible instability can be made, but is very difficult, and, transistor characteristic spreads being so wide, this aspect is usually covered by experimental testing.

A practical aspect of high-frequency compensation is the method of testing bandwidth characteristics. We have been thinking in terms of conventional sine-wave response measurements, but, with modern fast oscilloscopes available, it is often more convenient to inspect and measure the pulse response visually. This is where the "overshoot" mentioned earlier becomes significant, because the appearance of an overshoot on the output pulse leading edge gives an indication of impending instability that might not be evident from a continuous-signal bandwidth measurement. Usually a few per cent of overshoot is allowable to sharpen the leading edge of the output pulse before instability becomes a significant problem.

The analysis of high frequency compensation techniques given has been very approximate, ignoring many second order effects and making severe practical simplifying assumptions. However, the results will be found correct to a first order of magnitude. In general, it will be found that by judicious use of peaking techniques, bandwidths can be approximately doubled for any specified gain. Anyone seeking a more rigorous treatment should consult standard textbooks such as "Transistors—Principles, Design and Applications" by W. G. Gartner, Van Nostrand, 1960, or "Transistor Circuit Analysis" by M. V. Joyce and K. K. Clarke, Addison-Wesley Publishing Co. 1961.

Low-frequency Compensation

The low-frequency cut-off (or percentage droop—see (3)) of a linear pulse amplifier is not usually much dependent upon the characteristics of the transistors; it is determined by the same considerations as apply to extending the low-frequency bandpass limit of a conventional RC-coupled audio amplifier. The main limiting factors are the interstage coupling capacitor, C_K, shown in Fig. 30 (a), and the emitter decoupling capacitor, C_D, in Fig. 30 (b). The design values of C_K and C_D are usually chosen to give not more than 1dB attenuation each at the lower bandwidth limit, f_o, aimed at, so that in combination they give less than 3dB attenuation. A formula for the interstage coupling capacitor on this basis is:

$$C_K = \frac{3}{2\pi f_o(R_C + R_L)} \quad .. \quad .. \quad .. \quad (23)$$

and for the emitter bypass capacitor

$$C_D = \frac{3h_{fe_o}}{2\pi f_o R_s} \quad .. \quad .. \quad .. \quad .. \quad (24)$$

Another method of low-frequency compensation well known from valve practice can also be used with transistors as shown in Fig. 30(c). Here R_C and C_V

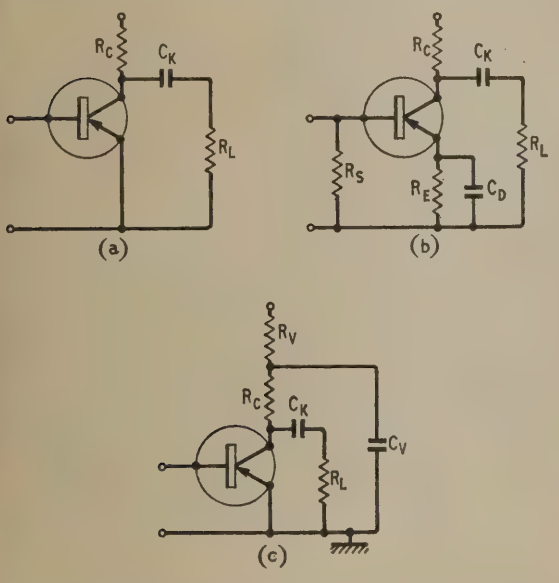


Fig. 30. Low-frequency response considerations. C_k in (a) and C_d in (b) both cause a fall-off at low frequencies. Circuit at (c) is one method of correction.

in parallel give bass boost, provided R_V is chosen as high as possible consistent with the supply voltage, and a value of C_V is selected:

$$C_V = R_L C_K / R_s \quad .. \quad .. \quad .. \quad .. \quad (25)$$

Transistors For Linear Pulse Amplifiers

When we use a transistor with a gain-bandwidth product, f_T, in a practical linear pulse amplifier stage, we generally find that due to various unavoidable losses in bias resistors, etc., it is not easy to attain an amplifier gain-bandwidth much more than 2/3 of f_T. Now transistors used in linear pulse amplifier fall into two main types: alloy and diffused base. The best commercially-available alloy types give a guaranteed minimum gain-bandwidth, f_{Tmin}, of about 6Mc/s, and these can be used to produce a stage with a gain-bandwidth of about 4Mc/s in practice, e.g. to produce a gain of 10 and a bandwidth of 400kc/s.

For higher gain-bandwidth requirements than this, recourse has to be made to diffused-base transistors, where a minimum f_T of 60Mc/s is now obtainable almost as cheaply as the 6Mc/s alloy type. Although the analysis given earlier applied primarily to alloy r.f types, it still holds substantially true for diffused types, so that gain-bandwidths of some 40Mc/s are easily obtainable in practice. In some of the ordinary linear pulse requirements, indeed, it may be found necessary to add circuit elements to restrict rather than to enlarge the amplifier bandwidth. Some diffused types with f_{Tmin} of 300Mc/s are now commercially available so that amplifiers with gain bandwidth products of 200 per stage are feasible.

Multistage Linear Pulse Amplifier

Where the desired amplifier gain cannot be obtained with one stage, it is possible to cascade linear pulse amplifier stages effectively. The gain of a single stage of the type discussed in detail above is given by

$$A_i = \frac{A_{io}}{1 + jf/f_b} \quad .. \quad .. \quad .. \quad .. \quad (26)$$

The gain of n identical stages would then be

$$A_{in} = A_i^n \quad .. \quad .. \quad .. \quad .. \quad .. \quad (27)$$

It can be shown that the overall bandwidth of n such stages is given by:

$$F_B = f_B/(1.2n^{\frac{1}{2}}) \quad .. \quad .. \quad .. \quad .. \quad (28)$$

if n is greater than 3. Thus we can see that the overall bandwidth shrinks as the square root of the number of stages. It will be found also that as n increases the overall gain-bandwidth increases at first, but finally falls off. This means that a point is ultimately reached where adding an extra stage merely reduces the total gain-bandwidth product.

Readers looking for more information on multistage linear pulse amplifiers should consult "Handbook of Semiconductor Electronics" by L. P. Hunter, McGraw-Hill, 1962.

High-level Linear Pulse Amplifiers

Linear pulse amplifiers are often required to furnish large peak-to-peak voltage swings with bandwidths of many Mc/s for such applications as driving the grid or deflection plates of a cathode ray tube. Maximum output may be limited by the transistor voltage ratings or by useful range of currents over which the transistor retains its high frequency performance. For a discussion of the practical problems involved the reader should consult "Transistor Television Receivers," by T. D. Towers, Iliffe Books Ltd., 1963.

In high-voltage linear pulse amplifiers with very wide bandwidths (over 25Mc/s), unavoidable wiring capacitances and transistor output capacitances forces the use of small resistance loads. The maximum output will then be limited by the maximum permissible current swing (or in other words, the

maximum dissipation). Where circuit strays, and not C_c, are the major frequency limiting factor, higher peak-to-peak load current can be obtained by parallelling transistors.

For frequencies less than 5Mc/s, the voltage rating of the transistor tends to be the main limiting factor at present. In this case the use of the common-base configuration is advantageous, since common-base usually permits higher collector current excursions before distortion or breakdown. Common-base has the further advantage that wide alpha bandwidth permits the collector voltage to swing closer to zero without distortion than is the case with common-emitter. Typical practice is to drive the common-base output stage from a high output-impedance common-emitter stage.

If a voltage swing greater than the transistor rated voltage is desired, it is possible to connect transistors in a stack employing signal feedback to ensure all transistors share the output voltage equally. Such a configuration is shown in Fig. 31.

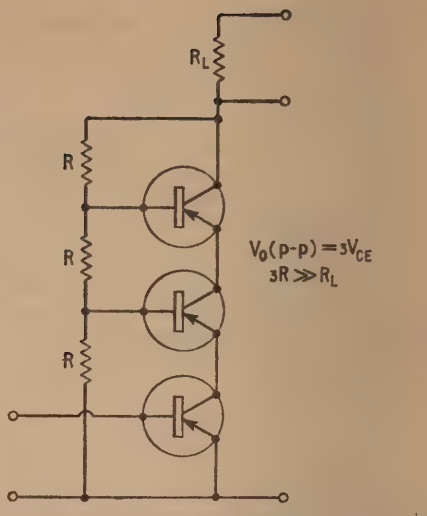


Fig. 31. Stacking transistors to give output swing greater than voltage ratings of individual transistors.

Conclusion

Modern transistors with gain-bandwidth products up to hundreds of megacycles make possible the use of transistors in most linear pulse amplifiers that are commonly required. Special cases requiring gain-bandwidths beyond this may require recourse to more exotic circuits such as transistor distributed amplifiers.

Commercial Literature

Evershed & Vignoles Ltd., of Devonshire Works, Dukes Avenue, London, W.4, have now issued the second in their series of coloured educational wall charts. This chart, in poster size, shows the insulation, continuity and voltage testing circuitry of the **Battery "Megger" Tester,** and in diagrammatic form illustrates the main principles of operation. The chart is available to training schools from the publicity manager and the company will also supply, on request, small educational leaflets supplementing the wall charts.

5WW 301 for further details.

A 28-page catalogue supplement (No. 135) describing recently introduced **switches and signal indicator lamps** is now available from Arcolectric Switches Ltd., of Central Avenue, West Molesey, Surrey. General and technical information is included together with dimensional diagrams.

5WW 302 for further details.

"Nickel Alloy Permanent Magnets in U.K. Electronics" is the title of a new illustrated publication produced by the International Nickel Company (Mond) Ltd. This publication deals with applications and copies are available from the Company's publicity department, 20 Albert Embankment, London, S.E.1.

5WW 303 for further details.

Catalogues covering a new range of **plugboard programming systems and accessories**—some of which are manufactured by the Virginia Panel Corp. of America—are now available from Jenkins Fidgeon Ltd., Linley Road, Talke, Staffs.

5WW 304 for further details.

A multi-range **frequency/tachometer** covering 3.f. to 500 kc/s is described together with a frequency deviation unit and a voltage deviation unit in a leaflet sent to us by Ledon Developments Ltd., of 76-78 Deptford High Street, London, S.E.8.

5WW 305 for further details.

"A New Construction Technique for the Hi-Fi Enthusiast" is the title of a leaflet giving details of Martin Audiokits. A 5-stage matching input selector unit, a pre-amplifier with master volume control, a 3-channel mixer with plug-in adaptors and a 10 watt amplifier are among the described kits. Copies of the leaflet are available from Martin Electronics Ltd., 154 High Street, Brentford, Middx.

5WW 306 for further details.

A brochure describing the newest addition to the E.M.I. range of **measuring oscilloscopes,** the WM26, is now available from the instrument division of E.M.I. Electronics Ltd., Hayes, Middx. Also included in the brochure is a range of plug-in pre-amplifiers and a full complement of accessories for the WM26.

5WW 307 for further details.

"Storage Equipment in Steel" is the title of the latest N. C. Brown Ltd. catalogue. It covers several types of shelving, cabinets, component bins, storage units, etc. Steel office furniture is also included. Copies of the catalogue are obtainable from N. C. Brown Ltd., Eagle Steelworks, Heywood, Lancs.

5WW 308 for further details.

The Addison Electric Company, of Belmont Road, London, W.4, has started to publish a quarterly house journal titled "Addison News." It is freely distributed to the **wire and cable industry**, which it serves, and other potential readers are invited to be put on the company's mailing list.

5WW 309 for further details.

Automatic graph plotting instruments, from analogue or digital sources, are described in a recent leaflet from the electronics division of Bryans Ltd., of Willow Lane, Mitcham, Surrey. A digital data translator, a function generator and automatic XY plotters are among the described instruments. Technical specifications of some models are included.

5WW 310 for further details.

and Now-
a Fully Transistorised Walkie-Talkie!

the PYE Bantam
TWO-WAY RADIOTELEPHONE

Once again in the tradition of the outstanding Cambridge and Vanguard Radio-telephones, Pye have produced the Bantam, a brilliant fully transistorised Walkie-Talkie.

- Fully transistorised Transmitter and Receiver
- Long endurance with Rechargeable or Dry Batteries
- Crystal Filter selectivity
- Reliability and accessibility of components
- Very high performance Receiver
- Lightweight 4 lbs. (1.82 kg.)
- Frequency Band 25-174 Mc/s.
- Weatherproof

PYE TELECOMMUNICATIONS LTD. CAMBRIDGE, ENGLAND · *Telex No.* 81166

5WW—091 FOR FURTHER DETAILS.

63

SELF CONTAINED RANGES

20,000 o.p.v.
50 megohms
Overload cut-out

Taylor

COMPREHENSIVE MULTIMETER

MODEL 88B

SELF CONTAINED RANGES

D.C. volts 0.1 to 2.5 Kv. in 13 ranges.
A.C. volts 1v. to 2·5 Kv. in 11 ranges.
D.C. current 50μA to 10A in 14 ranges.
A.C. current 1 MA. to 10A in 11 ranges.
Resistance 1 ohm to 50M in 5 ranges.
Decibels −10 to + 68dB in 9 ranges.
Total 63 Ranges!

ADDITIONAL FEATURES

- ★ *Robust Taylor centre pole moving coil 40μA movement.*
- ★ *5-inch mirror scale with coloured arcs.*
- ★ *Reverse polarity switch.*
- ★ *E.H.T. adaptor for 25Kv (Model 488).*
- ★ *Capacitance and inductance ranges with adaptor (Model 388).*
- ★ *High quality leather case available.*

List Price £23.10.0

Taylor

Write for full details.

TAYLOR ELECTRICAL INSTRUMENTS LTD.
Montrose Avenue, Slough, Bucks.
Telephone: Slough 21381.

M GROUP

5WW—092 FOR FURTHER DETAILS.

WORLD OF WIRELESS

B.B.C. Licence Renewed

THE "British Broadcasting Corporation (Licence and Agreement)," which covers the next 12 years and came before Parliament during December, has now been approved by the House of Commons. A number of detail changes have been made in some of the technical clauses of the 1952 licence (amended in 1961) and some have been deleted.

An interesting new clause (5) is that which deals with the reciprocal obligations of the B.B.C. and the I.T.A. in the sharing of aerial masts for the new u.h.f. television services. Mr. Mawby, Assistant P.M.G., stated in the House that the present "give and take between the two organizations" in the planning of the u.h.f. network has been remarkable. The I.T.A.'s obligations regarding the co-siting of stations are laid down in the Television Act, 1963.

The financial clause (17), which in the 1952 Licence and Agreement stipulated that the Corporation should receive an amount equal to 85% of the net licence revenue, now provides for it to have 100%, less Post Office expenses.

The B.B.C.'s income from licences during the past financial year, to March, 1963 (as taken from the B.B.C.'s 1964 Handbook), totalled £37,972,143, after deducting the Post Office expenses of £2,783,331. The Corporation also paid the Post Office nearly £1.75M for line, cable and telephone hire. After finding £20.9M for programmes, £10.7M for engineering and some £2.5M for capital expenditure plus general overheads, the B.B.C.'s reserves dropped to under £200,000.

The P.M.G., Mr. Bevins, again refused to increase the combined radio and television licence fee. However, the Government has increased the borrowing powers of the B.B.C. to £20M, for capital expenditure, which with the nation-wide introduction of BBC-2 will be considerable.

The question of local sound broadcasting was raised several times in the House during the debate. Mr. Bevins answered "I confess that before I came into the Chamber today I did not realize that the consensus of opinion here was so much in favour of local sound as it has appeared to be during the debate. The House knows that on earlier occasions the Government dismissed this recommendation of Pilkington. My mind is not closed on this subject. I would like to study the matter further in the light of what has been said, without giving any undertaking or promise to the House at this stage."

John Martin, who lost his sight during the war when serving in the Merchant Navy as a radio officer and is now an amateur transmitter (G3NTE), is featured in the St. Dunstan's Annual Report.

B.B.C.-2 Masts and Aerials

THE B.B.C. has ordered the aerials for its first two u.h.f. transmitters outside London. They will be mounted on top of the existing 750-ft masts at Sutton Coldfield, in the Midlands, and Wenvoe, South Wales. The aerials are the first of their kind to be used in this country and consist of a 5-ft diameter glass fibre cylinder 30 to 40ft in length on the inside of which the dipoles will be mounted. Although initially they will be used only for BBC-2 these aerials have been designed by Marconi's to radiate up to four programmes simultaneously.

In preparation for the co-siting of B.B.C. and I.T.A. transmitters at two existing I.T.A. stations—Winter Hill, Lancs., and Emley Moor, Yorks.—the Authority has ordered two new masts to replace the existing 450ft masts. That at Emley Moor will be 1,250ft tall and that at Winter Hill 1,000ft. Each mast will be capable of carrying four aerials for Bands IV and V, two for Bands I and III and one for Band II. A third mast, 1,250ft tall, is to be erected by the I.T.A. at Belmont, Lincs., where there will be a B.B.C./I.T.A. station. All three masts are to be built by B.I. Callender's Cables and will consist of a 9ft diameter steel tube, the top 350ft section being of open lattice steel construction. This longer topmast will be enclosed in glass fibre on which will be mounted the dipoles. Initially, only a Band III aerial, supplied by E.M.I., is to be fitted on each of these masts.

U.R.S.I.—The next triennial General Assembly of the International Scientific Radio Union will be held in September 1966 in Munich. This meeting will be preceded by a symposium on radio wave propagation to be held in Belgrade. The new president of the Union in succession to Dr. R. L. Smith-Rose is Professor I. Koga of Japan. The Union has published a volume recording progress during the 50 years since its formation. U.K. contributors include Dr. R. L. Smith-Rose, Sir Harry Massey, Dr. L. Essen, Dr. J. A. Saxton, Dr. W. J. G. Beynon and J. A. Ratcliffe. The 165-page volume costs 29s.

British Gift to Skopje TV Station.—In answer to a request to members of the European Broadcasting Union from the Yugoslav Radio and Television Service for help in providing equipment for the Skopje television station, which was a victim of last year's earthquake disaster, a three-camera outside broadcast unit has been dispatched from London. It is a joint gift from Associated-Rediffusion and Associated Television and has been converted—by Pye Ltd.—to operate on the 625-line standards.

The B.B.C.'s new television and v.h.f. sound **relay station for Pembrokeshire** comes into service on February 15th. Situated near Haverfordwest, the television transmitter will radiate in channel 4 and the sound transmitters on 89.3, 91.5 and 93.7Mc/s. All transmissions are horizontally polarized.

BBC-2 Test Card.—As a temporary measure the B.B.C. is using a modified test card "C" for the BBC-2 trade test transmissions, which were recently resumed with increased power on Channel 33. The five frequency gratings, which on the standard card indicate resolutions of 1, 1.5, 2, 2.5 and 3Mc/s, have been changed to indicate 1.6, 2.3, 3.1, 3.9 and 4.7Mc/s.

New I.T.A. Trade Test Schedule.—In order to achieve an adequate standard of maintenance the Independent Television Authority has announced that trade test transmissions from its parallel operated stations will be radiated at reduced power on two days a week, instead of one, during the hours of 10.0 a.m. to 1.0 p.m. The five stations concerned are:—

Black Hill (Central Scotland) Caradon Hill (Cornwall) Durris (near Aberdeen)	Wednesdays and Fridays
Mendlesham (Suffolk) Stockland Hill (Devon)	Tuesdays and Fridays

B.S.R.A.-B.K.S. Merger.—Negotiations have now reached an advanced stage for the amalgamation of the British Sound Recording Association and the British Kinematograph Society. The name of the joint society has not yet been decided and each organization is continuing its programme of meetings under its own name for the remainder of this session. Members of either society may now attend any of the other's ordinary meetings.

Commercial TV for Liberia.—A commercial 625-line v.h.f. television station operating on Channel 6, Band III, has been set up in Monrovia, Liberia, by Overseas Rediffusion Ltd. Negotiations to establish the station were concluded with the Liberian government on 6th December, 1963, and the station became operational one month later with an e.r.p. of 2.5kW. Pye T.V.T. Ltd. supplied all the transmitting and studio equipment.

U.H.F. 'phone-only licences are to be issued to amateurs as a result of discussions between the Post Office and the Radio Society of Great Britain. The new licence will permit the holder of a radio amateur examination certificate to operate on 'phone-only above 420 Mc/s. He will not have to pass a morse test.

The word "electronic" has been added to the title of the Department of Electrical Engineering at the **University of Birmingham.** Of the 68 postgraduate students, in what will now be known as the Department of Electronic and Electrical Engineering, 60 are concerned with electronic engineering.

Amplivox Ltd. are providing a **research bursary** in the Physics Department of Imperial College under the supervision of Dr. R. W. B. Stephens. The research will be concerned with the transmission of sound and vibrations in a variety of materials, and the behaviour of sub-miniature mechanical-acoustical systems embodying such materials.

Henry's Radio Ltd. ask us to inform readers who may have sent orders with money between 10th November and 31st December to 303, Edgware Road, London, W.2, that if they have not yet received acknowledgment, a claim should be lodged with the Post Office, who have the matter in hand. Henry's regret this inconvenience which has arisen through no fault of their own.

"Acoustic Noise Measurement and Analysis."—In the first equation, on p. 51 of this article in the January issue, it is regretted that multiplcation signs were set in error. The equation should read

$$N = 10 \log_{10} \left(\frac{p}{p_0}\right)^2 = 20 \log_{10} \left(\frac{p}{p_0}\right)$$

WIRELESS WORLD INDEX

The Index to Volume 69 (1963) is now available price 1s (postage 3d). Cloth binding cases with index cost 9s, including postage and packing. Our publishers will undertake the binding of readers' issues, the cost being 30s per volume including binding case, index and return postage. Copies should be sent to Associated Iliffe Press Ltd., Binding Department, c/o 4 Iliffe Yard, London, S.E.17, with a note of the sender's name and address. A separate note, confirming despatch, together with remittance should be sent to Dorset House, Stamford Street, London, S.E.1.

"The Physics Exhibition" is in future to be the title of the annual exhibition of scientific instruments and apparatus organized by the Institute of Physics & Physical Society. For the first time the 1965 exhibition is to be held in the provinces; the venue is the Manchester College of Science and Technology and the date 5th-8th April.

To celebrate the 75th anniversary of the **Electrical Inspection Directorate** of the Ministry of Aviation its headquarters and laboratories at "Aquila," Golf Road, Bromley, Kent, are to be opened to the public on the 6th, 7th and 8th May.

A two-day course on recent advances in **semiconductors applications** is to be held at Slough College, Bucks, on 18th and 18th March. Eight lectures will be delivered by specialists from Ferranti, G.E.C., Mullard and S.T.C. (Fee, including meals, £3 10s.)

P.A. Symposium.—The Association of Public Address Engineers is planning to hold its third symposium in Manchester on 20th September.

A two-day symposium covering the principles and applications of **digital and analogue computers** is to be held at the Norwood Technical College, Knight's Hill, London, S.E.27, on 24th and 25th March. (Fee £2 12s 6d.)

The tenth **v.h.f./u.h.f. convention** organized by the London U.H.F. Group of the Radio Society of Great Britain is to be held on 16th May at the Kingsley Hotel, London, W.C.1.

The **Technical Publications Association** is holding an exhibition "on technical publications as an aid to industry" in Birmingham on 4th April. Further details may be obtained from the Association's new address 17 Bluebridge Avenue, Brookmans Park, Herts. (Tel.: Potters Bar 55392.)

CLUB NEWS

Dorking.—The February 11th meeting of the Dorking & District Radio Society at 8.0 at the "Wheatsheaf," Dorking, will take the form of a discussion on receivers. On February 25th J. Green, of Decca, is to give a talk and demonstration on "Wiring techniques, printed circuits, etc." at 8.0 at the "Star & Garter," Dorking.

Halifax.—The subject of the talk to be given by F. C. Luxton to members of the Northern Heights Amateur Radio Society on February 19th is "Accidents in the shack, including electrical faults." Meetings are held on alternate Wednesdays at 7.30 at the Sportsman Inn, Ogden.

Plymouth.—Meetings of the Plymouth Radio Club are held each Tuesday at 7.30 at Virginia House, Bretonside. On February 4th a Mullard film show will be presented.

Spen Valley.—February's meetings of the Spen Valley Amateur Radio Society includes talks on "Noise Problems" (6th) by W. Dougherty and on "Colour Television" (11th) by Dr. G. N. Patchett. The meeting on the 6th will be held at 7.15 at the Heckmondwike Grammar School and that on the 11th at the Bradford Technical College.

PERSONALITIES

Martin Ryle, F.R.S., professor of radio astronomy at Cambridge University, is the first recipient of the van der Pol gold medal of the International Scientific Radio Union (U.R.S.I.). The medal, donated by Mrs. van der Pol in memory of her late husband, is to be awarded at each triennial general assembly "to an outstanding radio scientist who, during the three-year period preceding the year of the General Assembly, will have made a valuable contribution, in one of the fields of activity of the Union, either by his research work, discoveries, achievements, or by any other activity." Professor Ryle, who received the medal at the U.R.S.I. meeting in Tokyo in September, has been at Cambridge since the end of the war, initially as lecturer in physics at the Cavendish Laboratory and latterly at the University's Mullard Radio Astronomy Laboratory. He has occupied the University's chair of radio astronomy since it was established in 1959.

F. E. Jones, M.B.E., B.Sc., Ph.D., M.I.E.E., M.Brit.I.R.E., has been appointed managing director of Mullard Ltd. in succession to **S. S. Eriks,** K.B.E., who has headed the Mullard company since 1929. Dr. Jones, who is 49, joined the staff of the Telecommunications Research Establishment in 1940 after graduating from King's College, London. For his work on the wartime blind bombing system "Oboe" he was awarded the M.B.E. in 1945. Dr. Jones was appointed deputy director of the Royal Aircraft Establishment, Farnborough, in 1953. He resigned from the Civil Service three years later to join the board of Mullard Ltd. Dr. Jones was a member of the Radio Research Board of the D.S.I.R. until 1962. Mr. Eriks will remain a director of Mullard Ltd.

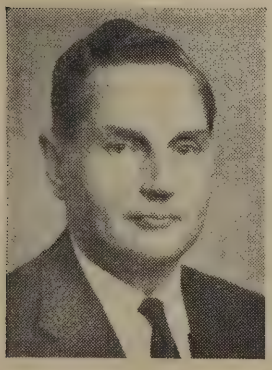
Bertram V. Bowden, M.A., Ph.D., M.I.E.E., principal of the Manchester College of Science and Technology and Dean of the Faculty of Technology at Manchester University since 1953 was appointed a life peer on December 23rd. Dr. Bowden, who is 53, spent three years in the Cavendish Laboratory, Cambridge, under Lord Rutherford and several years teaching before joining the Telecommunications Research Establishment, Malvern in 1940. He took a team from T.R.E. to the Naval Research Laboratory, Washington, to work on an aircraft identification system. From 1945 he was for a short time at the Massachusetts Institute of Technology, then with Sir Robert Watson-Watt's consulting organization for three years, and in 1950 he joined Ferranti's computer group.

H. V. Beck, B.Sc., M.A., A.M.I.E.E., who joined Marconi Instruments in January, 1962, as chief of advanced development, has been appointed research manager. Mr. Beck, who is a graduate of King's College, London, was from 1957 at the Cavendish Laboratory as head of the electronics section having previously been with the Cambridge Instrument Company. He is chairman of the I.E.E. Professional Group for Electronic Measuring Instruments and Techniques. **A. G. Wray,** M.A., M.Brit.I.R.E., the deputy chief engineer of the company since 1960, has been appointed engineering manager. Mr. Wray graduated at Emmanuel College, Cambridge, and joined the company in 1944 being appointed company physicist eight years later, He is a member of several committees of the British Standards Institution dealing with electronic measuring techniques and is chairman of the Programme and Papers Committee of the Brit.I.R.E.

Brigadier E. I. E. Mozley, M.A., A.M.I.E.E., has relinquished the post of Director of Telecommunications at the War Office and retired from the Army. Prior to his appointment in 1961 Brigadier Mozley was, for three years, commander of the Royal Signals Planning Wing at Catterick where he was concerned with advance planning in both the technical and tactical aspects of army communications. The new Director of Telecommunications is to be **Brigadier R. H. E. Robinson,** O.B.E., who was, until recently, Chief Signals Officer H.Q. Far East Land Forces, Singapore. Brigadier Robinson, who is 50, served in the Mediterranean area in 1943/4 where he commanded the 8th Army Signals. During 1951/52 he was with the British Joint Services Mission in the United States.

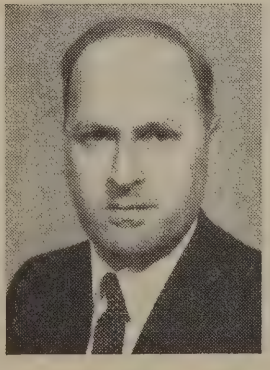
Gilbert A. Briggs, well-known founder of Wharfedale Wireless Works, has retired from the managing directorship of the company and has become chairman of the board. Mr. Briggs, who is 73, founded, in 1933, the company which has been a subsidiary of the Rank Organisation since 1958. He is well known for his many books on audio topics and for his enterprise in demonstrating recorded *versus* live sound as he did with such outstanding success on several occasions in the Royal Festival Hall, London, and on the other side of the Atlantic.

Brigadier J. D. Haigh, O.B.E., M.A., M.I.E.E., has been appointed planning manager of the Swindon Group of the Plessey Company. Before joining the Plessey Group in 1958, Brig. Haigh was director of electronics and development (telecommunications) at the Ministry of Supply.



Dr. F. E. Jones

H. V. Beck



A. G. Wray

Brig. J. D. Haigh

Professor P. M. S. Blackett, F.R.S., has resigned the headship of the Department of Physics at Imperial College, London, but is continuing as professor of physics and as pro-rector. Professor Blackett, who joined the staff at Imperial College in 1953, has served as a part-time member of the National Research Development Corporation and as a member of the Research Council of the Department of Scientific and Industrial Research. The new head of the Department of Physics is **Professor C. C. Butler,** F.R.S., who joined the college staff as a reader in physics in 1953 and has been professor of physics since 1957. Professor Butler, who is 41, and a graduate of Reading University, where he also received his Ph.D., was on the staff of Manchester University from 1945 until 1953.

R. J. Clayton, O.B.E., M.A., M.I.E.E., the new managing director of G.E.C. (Electronics) Ltd., joined the G.E.C. Research Laboratories in 1937 after graduating in physics at Cambridge University. He transferred to the G.E.C. Applied Electronics Laboratories at Stanmore in 1950 and later became manager. In 1958 he was appointed general manager of the group of three G.E.C. Applied Electronics Laboratories and after a short period in which he was additionally deputy director at the Hirst Research Centre he became a director and general manager of G.E.C. (Electronics) Ltd. in 1961. Mr. Clayton is chairman of the Research Advisory Committee of the Electronic Engineering Association and a member of the D.S.I.R. Radio Research Board. He has also served as chairman of the Guided Weapons Technical Committee of the Society of British Aircraft Constructors.

J. P. Engels has relinquished his position as managing director of Philips Electrical Ltd. to become vice-chairman of Philips Electrical Industries Ltd. **A. L. Sutherland,** director and general sales manager of Philips Electrical Ltd. has been appointed commercial director of the company. Mr. Sutherland joined Philips in 1933 and became a director of Cossor Radio & Television following its acquisition by Philips in 1959. The new general sales manager of Philips Electrical is **R. H. Pengelly,** M.B.E., who has been general manager of Cossor Radio & Television for the past two years.

Following Mr. Pengelly's appointment, **David Holmes,** Cossor's sales manager, has become general manager and a director of Cossor Radio & Television Ltd. He has been with the company for 12 years. His successor as sales manager is **F. N Filby,** who has been with Cossor since 1935.

John Clarricoats, O.B.E. (G6CL), retired at the end of the year after 36 years' service with the Radio Society of Great Britain. He had been general secretary since December 1932. When "Clarry" joined the Society its membership was under 1,000 but now stands at nearly 12,000. He is secretary of the European Area of the International Amateur Radio Union and has been a member of British delegations to many international radio conferences, the most recent being the Space Communication Conference in Geneva in October.

John Rouse, who joined the H.Q. Staff of the R.S.G.B. in 1952 as assistant editor of the *Bulletin*, has been appointed general manager. (The post of general secretary has been discontinued.) He served in Royal Signals during the war and from 1945-47 was instructor at the signal officers' training school at Mhow, India. While in the Services in India he operated as an amateur with the call VU2AD. His present call is G2AHL.

John Powell, M.A., D.Phil., assistant managing director of Texas Instruments Ltd., at Bedford, is to succeed **A. N. Provost** as managing director of the company. On leaving the R.A.F. in 1945, Dr. Powell spent three years at Queen's College, Oxford, followed by three years' post-graduate research at the Clarendon Laboratory. He then received a three-year research fellowship to the National Research Council, in Ottawa, Canada, to investigate the properties of semiconductors. On his return to England in 1954, he spent three years with the Marconi Company before joining Texas Instruments. Dr. Powell was appointed vice-chairman of the Group B management committee of V.A.S.C.A. in 1961. Mr. Provost has become semiconductor group manager for Europe, the Middle East and Africa, and is to take up residence in Geneva. He spent some time with Sylvania Electric Products before joining Texas Instruments Inc., in Dallas.

G. A. G. Rowlandson has succeeded **R. Roper** as the senior sales engineer of the merchandising division of the Solartron Electronic Group. After spending several years in the Royal Corps of Signals, Mr. Rowlandson joined the staff of the radio department of the Royal Aircraft Establishment at Farnborough. Four years later he became a division engineer with Southern Instruments and before joining Solartron in 1959, spent two years with Honeywell Controls and two years at King's College, London. Mr. R. Roper has become general sales manager (communications) of Cossor Communications Company.

G. C. Pope, M.Eng., A.M.I.E.E., who joined Advance Components Ltd. of Hainault, Essex, in March 1963, and became general manager, has been appointed a director and joins the Board. He specialized in electronics at Liverpool University and then spent 12 years with the A.E.I. Group becoming sales manager of the Radio and Electronic Components Division in London. **A. W. Stapleton** formerly chairman and joint managing director has become chairman of Advance Components; **H. E. Howard** is now deputy chairman, and **E. G. Wakeling,** A.M.I.E.E., formerly joint managing director has become managing director. Mr. Wakeling joined Advance in 1959 having formerly been manager of the servo division of Elliott Bros. at Lewisham.

Peter Jones, A.M.Brit.I.R.E., who was engineer-in-charge of test and development with Leevers-Rich Equipment Ltd. until a few years ago, has rejoined the company as general manager in succession to **E. D. Parchment,** A.M.Brit.I.R.E., who has left the company. Mr. Jones was, for a short time, with Tape Recorders (Electronics) Ltd. and latterly as an assistant editor with Heywood & Co. Mr. Parchment joined Leevers-Rich in 1959, as technical sales manager, and became a director the following year.

OBITUARY

Sir Reginald Payne-Gallwey, Bt., Comp.I.E.E., a well-known figure in the councils of the British radio industry, died on 12th January, aged 74. Sir Reginald, who succeeded to the baronetcy on the death of his cousin in 1955, was for 28 years associated with the Erie Resistor Company as a sales consultant until his retirement last year. He had been a member of the Council of the Radio Industry Club for many years and was an associate vice-president of the London Chapter of the Armed Forces Communications and Electronics Association.

David N. H. Lambert, B.Sc., A.M.I.E.E., resident engineer at the B.B.C's Far Eastern broadcasting station at Tebrau, Malaya, died at Johore on 18th December, aged 57. He had been with the Corporation since 1934 and was, for ten years or so, in the Research Department before being appointed assistant engineer-in-charge of the Burghead, Scotland, medium-wave transmitting station in 1951. Four years later he was seconded to Radio Belize, British Honduras, as chief engineer. He returned to this country in 1958 and was for three years engineer-in-charge of the Clevedon, Somerset, transmitting station prior to his Far Eastern appointment.

NEWS FROM INDUSTRY

Group Trading Profit of **Radio Rentals Ltd.,** of which Baird Television is a subsidiary, totalled £7,781,544 in the year ended 31st August 1963. This represents an increase of over £1M on the previous year's results. After deducting £4,651,742 for depreciation, £1,357,382 for tax and £16,870 for minority interests, the net profit of the group totalled £1,755,550.

S.T.C.-Eimac Klystrons.—As a result of an agreement signed between the American companies Eitel McCullough Inc. and the International Telephone and Telegraph Corporation, Standard Telephones and Cables Ltd.—British subsidiary of I.T.T.—is to manufacture the Eimac range of u.h.f. television klystrons at its Paignton, Devon, plant. Initial production at Paignton for the U.K. and export markets will concentrate on klystrons with power outputs of 25kW.

Invac Data Equipment.—Associated Automation Ltd., a member company of the Elliott-Automation Group, has signed a licensing agreement with the Invac Corporation of Waltham, Massachusetts. The agreement allows Associated Automation to manufacture and market the Invac range of equipment in the United Kingdom, the British Commonwealth (excluding Canada), Europe and the Middle East. This includes the new range of peripheral equipment for data processing, data logging and data communications applications.

An intercommunication system has been installed by the Marconi International Marine Co. at Esso Petroleum's oil terminal at Purfleet, Essex. The system which has an integrated fire alarm system is similar to that recently installed at Esso Petroleum's new terminal at Tynemouth and comprises a main control unit installed in the despatching office block, and a number of loudspeaker/microphone units located at strategic points in the terminal. At each of the outstation positions there is a "break glass to operate" watertight fire call switch. The breaking of the glass automatically brings the fire circuits into operation and broadcasts an interrupted 1,000c/s tone over all loudspeakers.

Radio Towers for Cyprus.—British Insulated Callender's Construction Co. has received an order, valued at £74,000, from the Marconi Company for the supply of 16 radio communication towers. They are to be erected in Cyprus.

Elliott Airborne Radio Equipment.—Two recent contracts placed with the airborne communications division of Elliott-Automation for "Series 21" navigation and communications equipment brings the total value of orders for this equipment to well over £1,500,000. The "Series 21" installations which are priced at about £20,000 each comprise a dual v.h.f. communications and a dual v.h.f. navigation (V.O.R./I.L.S.) system with an additional glide path receiver—to comply with the requirements of the automatic landing regulations. The R.A.F. already have a number of these installations in operational use in their Argosy, Comet IV and Heron aircraft.

British Relay Ltd. have installed a communications system in the recently completed New Ambassadors Hotel in London. The installation comprises two intercommunication systems linking each bedroom with the hotel reception and room service. A four-programme radio distribution system is integrated in the intercom system.

The research branch of the Engineering Department of the Post Office has placed a contract, to the value of £28,000, for two data logging systems with the **Solartron Electronic Group,** Farnborough, Hants. The equipment will be used for the measurement and recording of the electrical parameters of planar type transistors.

The Marconi Company is to supply the transmitting equipment for a new **broadcasting station at Dar-es-Salaam,** Tanganyika. This will form part of an extension to the Tanganyika broadcasting service and will include two Marconi 50-kW medium-wave transmitters, together with programme input equipment and ancillaries. The associated aerial system will also be supplied by the Marconi Company.

Erie Resistor Ltd., of Great Yarmouth, Norfolk, has acquired a 31,300 sq. ft. factory at Arminghall, near Norwich.

Handley Page Ltd. are operating an **analogue computer service** from their Cricklewood works, London, N.W.2. The equipment on hire comprises four Short & Harland general-purpose consoles; each of which may be hired for £15 per day. Further details can be obtained from R. S. Skelton, Analogue Computer Department. Tel.: GLAdstone 8000.)

Elliott-Automation has opened a second **computer workshop** in the London area at Snow House, 103/109 Southwark Street, S.E.1 (Tel.: WATerloo 7640 and 7561). It is equipped with an Elliott 803 computer with a magnetic core store and a floating point arithmetic unit. The computer can be hired, together with accessories, on an hourly basis and operating and programming assistance is available. The workshop is open 24 hours a day, five days a week.

A new company to be known as **Export Engineering Services Ltd.** has been formed to provide a technical representation service for engineering companies in overseas markets. The managing director, P. E. M. Warden, A.M.I.E.E., was previously with the B.T.H. Company. The new Company will operate from Greystones, Cavendish Road, Weybridge, Surrey (Tel.: Weybridge 45202).

All this and parametric amplification too . . . *Using this array, with parametric amplifiers to boost the signal level, Rediffusion are planning to relay BBC—2 to their Southampton subscribers immediately the service comes into operation in the London area—20th April. The aerial is sited four miles outside the town and a cable connects it to the Company's distribution centre.*

B.O.A.C. using Cossor Transponders.—The British Overseas Airways Corporation has purchased a number of "SSR 1600" airborne transponders from Cossor Electronics Ltd. This type of secondary surveillance radar transponder, which has full 12-bit encoding facilities, is installed in VC10, BAC111 and Trident aircraft.

Amphenol-Borg (Electronics) Ltd. has been formed to carry on the business previously conducted by the electronics division of Amphenol-Borg Ltd. of which it is a wholly owned subsidiary. It will operate from Thanet Way, Whitstable, Kent. (Tel.: Whitstable 4345.)

Ten trawlers now being built in British shipyards for Irvin & Johnson Ltd., of Cape Town, are to be fitted with **Marconi Marine equipment.** The installations, which will be identical, will include radiotelephone, direction finding and fish-finding equipment. Marconi Marine are also supplying and installing communications equipment in the new British built 8,000-ton passenger-cargo vessel *Centaur*.

Gertsch Products Inc., of Los Angeles, whose equipment is handled in the U.K. by Wayne-Kerr Laboratories Ltd., of New Malden, Surrey, has been acquired for $3,503,510 by the Singer Company, Connecticut, U.S.A.

Racal Electronics Ltd. have received over £1M worth of orders for their 7½kW single-sideband transmitter-receiver installations in recent months. The equipments are automatic in operation and provide over 250,000 alternative channels, by means of a synthesizer driven from a precision frequency source. The installations, which are being used for ground-to-air communication by the R.A.F., can be controlled over a single pair of Post Office lines.

The southern area office of **Acheson Colloids Ltd.** has moved from Richmond, Surrey, to 1 Finsbury Square, London, E.C.2. (Tel.: MONarch 5813.)

W. H. Sanders (Electronics Ltd.) and its associated companies Arrow Ltd. and Sanders Overseas Microwave Agency Ltd. have opened a northern sales office close to Manchester Airport. The full address is: Office B2, Haletop, Civic Centre, Wythenshawe, Manchester, 22. (Tel.: Mercury 1703.)

Sound Coverage Ltd., the audio equipment company formed 18 months ago, has moved to larger premises at 7-9 Kew Green, Kew, Surrey. (Tel.: RIChmond 5438/9.) E. Trevor Thomas has joined the company as joint managing director, with responsibility for mechanical design, from Pamphonic Reproducers Ltd.

Hebrides Radio Equipment.—The Ministry of Aviation has placed an order with A. T. & E. (Bridgnorth) Ltd. for v.h.f. communications equipment to be installed at Stornoway and Mangersta on the Isle of Lewis, in the Outer Hebrides. Multichannel duplicated radio terminals, with automatic changeover facilities are being provided, together with aerials, ancillary and test equipment. The Mangersta station will be remotely controlled from Stornoway and the link will, in one direction, carry audio and control switching signals for modulation and control of the transmitters, and in the other, the audio output of the receivers. A two-way engineering circuit is also being provided.

British Oxygen Cryoproducts has been set up by the British Oxygen Company to concentrate, as its name implies, on deep low temperature techniques and engineering. Among the company's products is liquid helium which is used in masers, for superconductive magnets and in the production of very high vacua.

Rank Cintel, a division of The Rank Organisation, has received an order for about £6,000 worth of industrial electronic metal detection equipment from Sidwell Timbers of South Africa. The equipment is to be installed into production lines processing blockboard from second-hand timber.

NEW YEAR HONOURS

AMONG the recipients of awards in the New Year Honours List were the following in the world of radio and electronics:—

Knighthoods

Jules Thorn, chairman and managing director, Thorn Electrical Industries.
John Toothill, C.B.E., Comp.Brit.I.R.E., director, Ferranti.

K.C.M.G.

Hugh Carleton Greene, O.B.E., director general, British Broadcasting Corporation.

C.M.G.

I. K. Mackay, director general, Nigerian Broadcasting Corporation.

C.B.E.

Brig. J. F. Mc L. Mellor, O.B.E., D.F.H., M.I.E.E., Corps of Royal Electrical and Mechanical Engineers.
R. E. Sainsbury, director general of guided weapon and electronic production, Ministry of Aviation.
J. A. F. Somerville, Government Communications Headquarters.
Brig. T. R. Warburg, late Royal Signals.

O.B.E.

D. W. Bushe, lately engineer-in-charge of radio station, Berbera, Sudan.
Col. D. Dibsdall, B.Sc., A.M.Brit.I.R.E., late Royal Signals.
E. W. Hayes, M.I.E.E., head of planning and installation department, B.B.C.
K. I. Jones, Assoc.I.E.E., chief engineer, Ferguson Radio Corporation.
Lt. Col. J. H. Mansfield, Royal Signals, T.A.
E. Potts, M.I.E.E., assistant director (engineering), head of radio design staff, Headquarters, Signals Command, Air Ministry.
L. A. Robinson, engineer-in-chief, Posts and Telecommunications Department, British Guiana.
E. C. Slow, B.Sc., A.M.I.E.E., senior principal scientific officer, Royal Radar Establishment.
R. W. White, B.Sc., F.Inst.P., A.M.I.E.E., assistant staff engineer, Post Office Research Station, Dollis Hill.

M.B.E.

Major J. S. Birch, Royal Signals, T.A.
A. A. Coker, engineer-in-charge (sound), B.B.C., Bristol.
E. A. Davis, station radio officer, Government Communications H.Q.
J. B. L. Foot, A.M.I.E.E., research engineer, G.E.C. (Electronics) Ltd.
W/O. J. D. Francis, Royal Signals.
J. C. Mann, 1st radio officer (Marconi Marine), *S.S. Empress of Britain*.
J. R. M. McNally, general manager, Beckman Instruments, Ltd.
C. Nicolson, B.Sc., senior experimental officer, D.S.I.R. Radio Research Station.
E. D. Northcott, Directorate of Electronic Production (Telecommunications), Ministry of Aviation.
Capt. R. Prendergast, Royal Signals, T.A.
Major G. Proudman, Royal Signals.
F. L. Reed, Government contracts manager, E.M.I. (Electronics) Ltd.
E. P. Sim, assistant director, engineering division, Australian Post Office.

B.E.M.

Acting Chief Radio Electrical Artificer (Air) E. S. Barrett, R.N.
R. T. Bedford, inspector (radio line plant), Australian Post Office.
O. E. Cooper, supervising technician, Paddington Terminal, Overseas Telecommunications Commission, Australia.
Chief Radio Supervisor J. D. Foster, R.N.
T. W. Goford, lately supervising technician (radio), Department of Civil Aviation, Alice Springs, Australia.
W/O B. G. Green, Royal Signals.
Leading Radio Electrical Mechanic P. W. M. Griffioen, Royal Australian Navy.
Cpl. R. D. Holdsworth, Royal Signals.
A. Lee, technical officer, Post Office Research Station, Dollis Hill.
Chief Radio Supervisor (W) L. McWalter, R.N.
Sgt. A. F. Moon, Royal Signals.
Chief Radio Electrician T. G. Rennie, Royal Naval Reserve.
Sgt. J. K. Roberts, Royal Signals.
Chief Radio Supervisor V. J. Stuart-St. Clair, Royal New Zealand Navy.
C. Xerri, technical assistant, 234 Signal Squadron, War Office, Malta.

Royal Victorian Medal

Chief Communications Yeoman R. W. Fisher, R.N.

POINT-TO-POINT REVIEW: 1963

By P. A. C. MORRIS,* B.Sc., A.M.I.E.E.

IN reviewing the practice and performance of point-to-point communications systems during 1963 one is obliged to begin with mention of submarine coaxial cables. For, in the last month of the year, the most challenging route to the long-distance communicator, London-Australia, was spanned with a high-performance 80-channel link. For the first time a continuous telephone service became available between the antipodes. Nor was this the only achievement for, earlier in the year, a 128-channel cable was laid between Jamaica and Miami, whilst a fourth telephone cable was laid across the Atlantic—from New Jersey to Cornwall.

Although the h.f. radio system that has linked Australia to Britain for 37 years is now relegated to a stand-by role, this should not be taken as being typical of a fate universally befalling radio. A recent study by Lee and Cannon† of the growth of h.f. telex and leased telegraph channels on routes not served by coaxial cables shows an expansion rate of about 60% per annum—a remarkable figure for any undertaking and certainly not indicative of decline. What this means is that there is a great deal of difference between the types of system that are appropriate to routes requiring more than about 20 kc/s of aggregate bandwidth capacity and those requiring less. For large areas of the world the lower capacity is sufficient at present and so there is considerable interest in securing the most efficient use of the h.f. band.

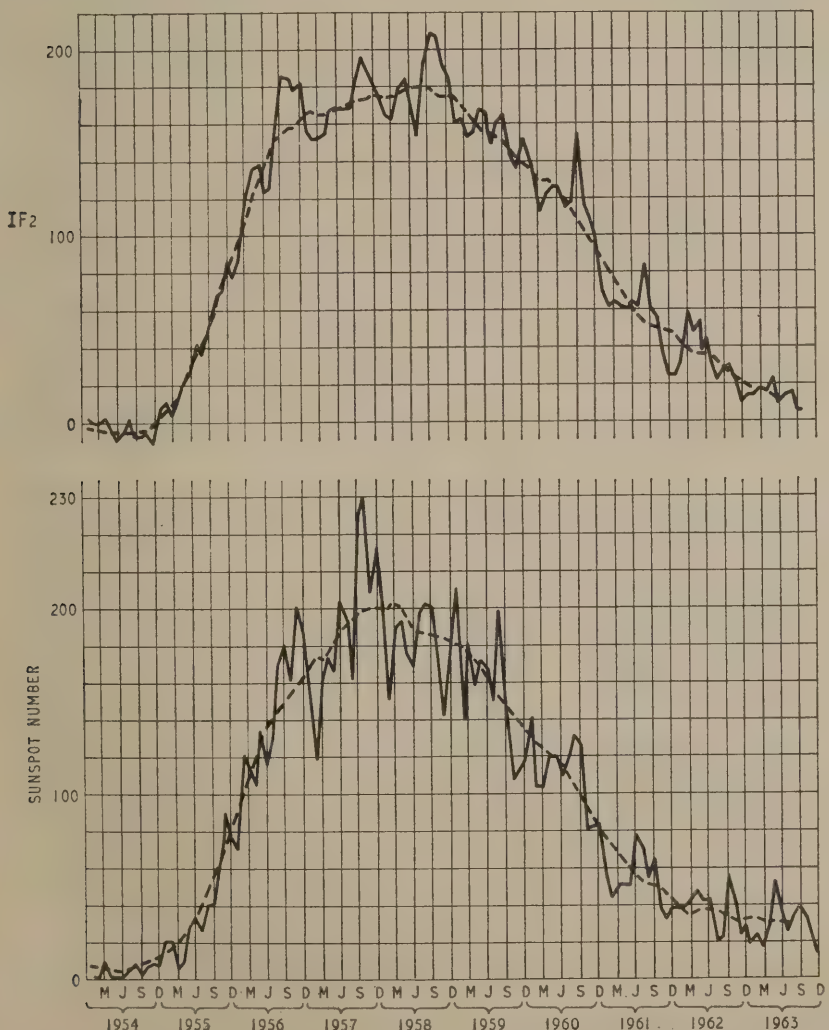


Fig. 1. The monthly and smoothed values of the sunspot number and the ionosphere index (IF2) for the past ten years.

This fact was emphasized by publication during 1963 of the Report of the Panel of Experts which was set up by the International Telecommunication Union to study ways of reducing congestion in the band. Many of its 33 technical recommendations underline the principles of good practice, which very often hinge upon the use of modern and efficient installations. Others cover the frequency tolerance of transmitters and spurious emissions, whilst great importance is attached to the abandonment of d.s.b. operation in favour of s.s.b. However, 11 recommendations cover the provision, wherever possible, of alternative systems ranging from line-of-sight microwave links, tropospheric scatter, and satellites, in addition to submarine coaxial cables. One would scarcely take issue with the Panel on the wisdom of providing these alternative methods of communication, but it is

* Cable & Wireless Ltd.

† Lee, W. H., and Cannon, R. W. Documents of I.E.E. Convention on H.F. Communication, March, 1963.

nevertheless, true that most organizations have been installing them just as soon as they can be shown to be economically justified.

Why is it that h.f. radio remains so attractive for lower capacity routes? The quick answer is that it is the cheapest system. Even when thoroughly well engineered, an h.f. link is far cheaper than a coaxial cable on a cost-per-channel-mile basis. On this basis one could afford to double the expenditure on a radio system and produce considerably higher circuit efficiencies since the amount of lost time per day on a radio link varies inversely with the expenditure on its provision. But at root the reason is the complex variability of the propagation medium and the strong diurnal influence in this variability. This is quite unlike the characteristic of, say, v.h.f. propagation in which, while the path attenuation often varies within the same order of magnitude, it does so with no certainty of communication within any given period. If an h.f. radio system works at all one can practically guarantee that it will work at some time within *any* 24 hours. The simplest of equipment will provide some sort of service at the optimum time of day, whilst it is only when continuous service is required that massive installations are required. As an example, during June, 1963, the yacht *Rehu Moana* operated a radiotelephone over a range of 1,000 miles into the G.P.O. network using only 75 watts, whilst a continuous commercial service might require 10 kW for the same distance.

The question of the proper level of expenditure on h.f. systems became a topical one during the year on account of further progress in the field of oblique-incidence sounding equipment. In the review of 1962 mention was made of the potential value of sounders in giving an instantaneous measurement of propagation conditions over a radio path: the system uses a synchronized sweep-frequency pulse transmitter and receiver at either end of the circuit. In June representatives of many organizations witnessed a demonstration of this equipment working across the Atlantic and a number of them were impressed with the possibility it opened up of matching the usage of radio frequencies to the *measured* maximum usable frequency. Test equipment is normal in radio stations to monitor the performance of transmitters and receivers and here was the apparatus to monitor the propagation path.

The snag, of course, is the cost which amounts to the equivalent of a high-power transmitter itself. But it is in this sort of context that the foregoing discussion on the cost of operating a radio link has relevance.

However, to continue our review of developments in 1963, we shall now turn to the longer-term influence of the solar cycle on h.f. communications.

The surprising fact to be reported is that there has been practically no change in the general level of solar activity during the year. After a steady decline from the maximum in 1958 the running average sunspot number has remained around 30 throughout 1962 and 1963. This is quite unlike the last cycle ending in 1953, and indeed one has to go back to the mimimum of 1876 to find anything at all similar. It is tempting to suppose that the sunspot number will not fall any lower and that the new cycle will appear at any moment: the fact that a sunspot characteristic of the beginning of a new cycle was observed in August lends some support to this view. However, past records show that the smoothed sunspot number invariably drops below 10 so that a further fall must be expected yet. Fig. 1 shows the monthly and smoothed values of both the sunspot number and the IF2 index; the latter gives the measured variation in ionization of the F-layer and is published by the D.S.I.R. Radio Research Station, Slough. It is interesting to note that this index reveals the decline of solar ionizing radiation which is not shown by the sunspot number.

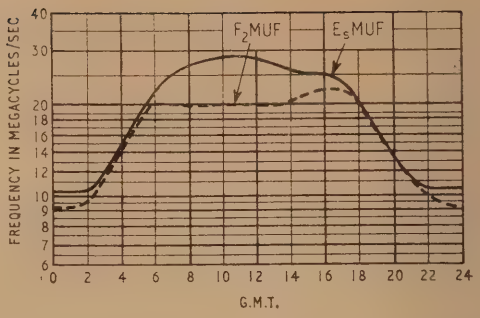


Fig. 2. London-Nairobi predictions for June 1963 showing sporadic-E(E_s) enhancement.

In general the performance of radio circuits has been maintained at the same level as in 1962. There were nevertheless events worthy of note such as the severe interruptions to services during ionosphere storms in September and October: during the latter half of September there were several flares which led to storms causing Dellinger-type fades and the same active area of the solar disk returned a month later after the sun's rotation causing similar disturbances. Examination of circuit logs for the period of these storms draws attention to the fact that only routes traversing high latitudes are seriously affected.

The expected influence of sporadic-E ionization on propagation during the summer period duly appeared. Operating frequencies around 15% higher than the predicted F2 MUFs were consistently used, especially on easterly routes from London. Normally no account of sporadic-E is taken in drawing frequency prediction curves because of its variable nature. However, the U.S. Central Radio Propagation Laboratory does publish forecast data which can be used to draw predictions of the median MUF due to sporadic-E. The appropriate curves have been drawn in Fig. 2 for the route London-Nairobi and it will be noted that the full-line sporadic-E MUF matches up very well with the actual frequency usage of 21 Mc/s in daytime.

It is during the solar minimum years, when F2 MUFs are depressed, that the sporadic-E effect is important and during next summer it will be especially valuable to have the use of higher frequencies which these curves indicate will be available.

Finally, in the field of satellite communications the event of the year was the successful launching of the experimental synchronous satellite Syncom II in July. From a quasi-stationary position over the Atlantic it has demonstrated the possibility of a relay in the 22,000-mile orbit.

1=6

H.F. WAVE ANALYSER TYPE 853 =

1 **An Analyser**

2 **A field strength and interference measuring set**

3 **A Selective Voltmeter**

4 **A Heterodyne Wavemeter**

5 **Transmission measuring set**

6 **A Bridge detector**

30kc/s — 30Mc/s — and highly versatile

The Airmec H.F. Wave Analyser Type 853 is a selective measuring set of great versatility, suitable for use in the frequency range 30 kc/s—30 Mc/s. The sensitivity of the amplifier enables measurements to be made from 1 microvolt to 1 volt up to a frequency of 20 Mc/s and from 4 microvolts to 4 volts above this frequency. This instrument has many uses as an Analyser, Selective Voltmeter, Transmission Measuring Set, Field Strength and Interference Measuring Set, Bridge Detector and Heterodyne Wavemeter.
Above 30 Mc/s we recommend the use of an Airmec V.H.F. Wave Analyser Type 248 (range 5 to 300 Mc/s). Full details of either of these two instruments, which form part of the comprehensive range of high quality electronic Instruments produced by Airmec for use in Laboratories and Workshops, will be forwarded to you upon request.

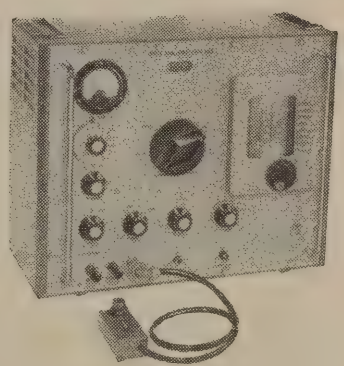
FREQUENCY RANGE:
30 kc/s — 30 Mc/s in 7 bands

SIGNAL INPUT RANGE:
1μV — 1V up to 20 Mc/s
4μV — 4V from 20 — 30 Mc/s

ATTENUATOR RANGE:
H.F. Attenuator:—
0, 10, 20, 40 and 60 dB
L.F. Coarse Attenuator:—
0 — 60 in 10 dB steps
L.F. Fine Attenuator:—
3 — 10 dB variable

ATTENUATOR ACCURACY:
± 0.1dB over 105dB range
± 0.5dB over 120dB range

INPUT IMPEDANCE:
75 ohms. A high impedance probe also provided.



Airmec for peak performance consistently

LABORATORY INSTRUMENTS DIVISION

Wave Analysers, Signal Generators, Oscilloscopes, Valve Voltmeters, Phase Meters, High Speed Counters, Ohmmeters, etc.

AIRMEC LIMITED HIGH WYCOMBE BUCKS ENGLAND
TELEPHONE: HIGH WYCOMBE 2501 (10 LINES)

5WW—093 FOR FURTHER DETAILS

AP 277a

E88CC BRIMAR

IMMEDIATELY AVAILABLE

Special Quality, Long Life Miniature Double Triode, WITH LOW CATHODE INTERFACE IMPEDANCE featuring a high mutual conductance and low drift of characteristics over long periods of operation

The E88CC has frame grids and gold plated pins.

for Application in:

LOW NOISE CASCODE AMPLIFIERS

WIDE BAND AMPLIFIERS

HIGH SPEED SWITCHING CIRCUITS

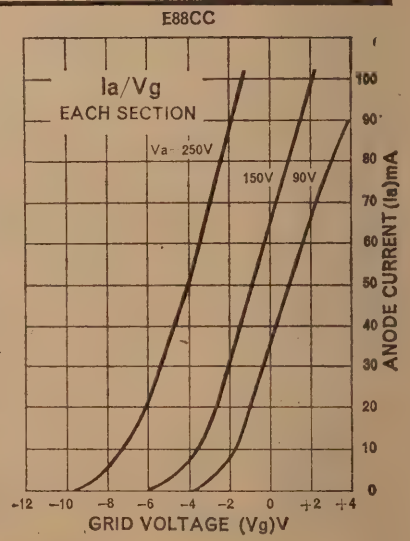
COMPUTERS

CIRCUITS WHERE STABILITY OF CHARACTERISTICS & LONG LIFE ARE CALLED FOR

Please ask for data sheets

OPERATING CHARACTERISTICS (EACH SECTION)

Heater Voltage	Vh		6·3		V
Heater Current	Ih		0·3		A
Cathode Resistance	R_K		680		Ω
Anode Supply Voltage	$Va_{(b)}$		100		v
Grid Voltage	$Vg_{(b)}$		+9		V
		MIN.	BOGEY	MAX.	
Anode Current	Ia	14·2	15	15·8	mA
Mutual Conductance	gm	10·5	12·5	15	mA/V
Amplification Factor	μ		33		
Anode Impedance	r_a		2·65		kΩ



Thorn-AEI Radio Valves & Tubes Ltd.

COMMERCIAL DIVISION: 155 CHARING CROSS ROAD · LONDON, W.C.2 · Telephone: GERrard 9797

BRIMAR EXPORT DIVISION: THORN HOUSE · UPPER ST. MARTIN'S LANE · LONDON, W.C.2

5WW—094 FOR FURTHER DETAILS.

Physical Society Exhibition Review

Highlights as seen by the Staff of *Wireless World*

THE Exhibition Committee have for several years been fighting what appeared to be a losing battle to subdue the purely commercial aspects of the exhibition. This year, however, a considerable measure of success was achieved, and new equipment was not diluted by all the old models in makers' catalogues. A welcome innovation was the section devoted to educational exhibits; much more attention is being paid to instruments specifically intended for teaching purposes, perhaps as a result of the Nuffield committee interim report.*

Measuring Instruments

Oscilloscopes:—Transistor oscilloscopes have, until fairly recently, been somewhat thin on the ground, possibly because the length of the tube means that size cannot be significantly reduced, and because either a mains supply or large batteries are needed, largely nullifying the advantages of transistor working. Two instruments were seen this year, however, the Cossor CD100 and the E.M.I. WM41.

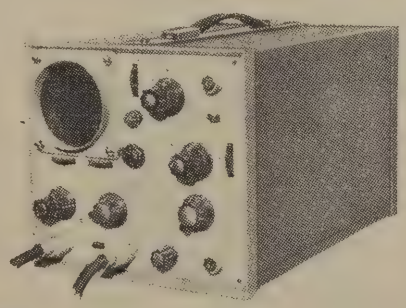
The CD100 is a modular oscilloscope, consisting of a main frame, carrying power supplies and tube, and a large aperture to accept separate or combined y and x deflection units. An advanced specification is offered and units are available for bandwidths up to 35 Mc/s and sensitivities up to 500μV/cm. Swept-frequency oscillator heads and u.h.f. sampling units are also designed for the instrument. Nuvistors are used to obtain high-input impedance amplifiers, and bootstrap circuitry is used in the timebase units. Y-delay is 153 nsec, achieved by means of a remarkably simple delay line. This is an example of the "why-has-no-one-thought-of-it-before" category of devices and consists simply of two lengths of p.v.c.-covered wire closely wound in opposite directions round a flexible former, which plays no part in the operation. The characteristic impedance is 220Ω, bandwidth up to about 50 Mc/s and delay about 20 nsec per foot. There is no cross-talk between adjacent coils when it is folded into a small space.

E.M.I. showed the prototype of their WM41 10 Mc/s instrument, which again uses valves in the input stages of the y amplifier. Several novel features were noted, among them being the power supply. When powered by a 12-V battery, the main supply, e.h.t. line and calibrating square wave are all derived from a transistor 7 kc/s inverter. Considerable economy is achieved in this way. The timebase, which sweeps at a maximum rate of 0.2/μsec/cm, is a bootstrap, constant-speed, triggered type in which the flyback time is variable to obtain locking. A tunnel diode is incorporated in the trigger circuit. No y delay is used. The unit is very compact and two can be fitted side-by-side in a 19-in rack.

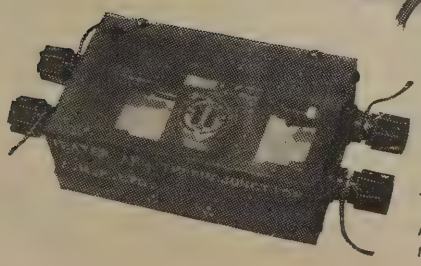
Current Measurement:—The properties of bismuth telluride have been employed by A.M.F. in a copper/bismuth telluride thermoelectric ammeter. The alternating or direct current is passed through a metal strip in thermal contact with the junction. The bismuth telluride is in the form of a pointed slug, narrow copper foil being used to reduce heat loss, the junction thus having a short response time. The relation between current and junction voltage is approximately a square law.

Testmeter:—An electronic equivalent to the well-known "AVO" was shown by Avo Ltd. This comprises two completely separate transistor amplifiers for a.c. and d.c. measurements. The d.c. amplifier is a long-

*"The Teaching of Modern Physics."

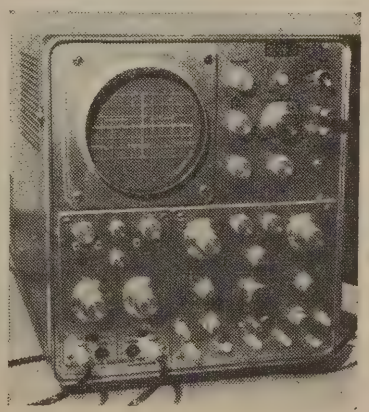


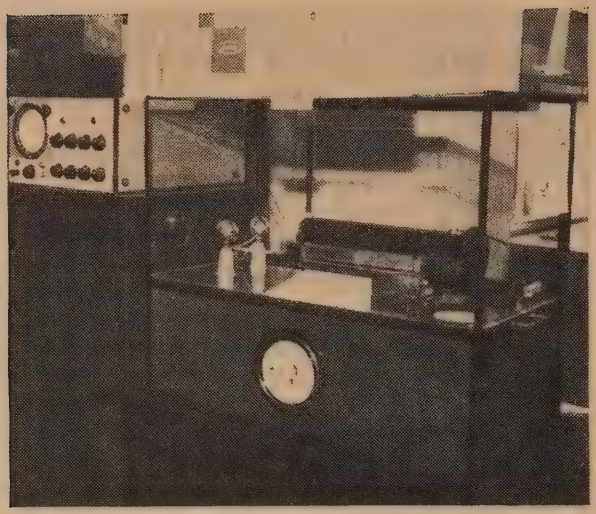
E.M.I. 10Mc/s transistor oscilloscope.

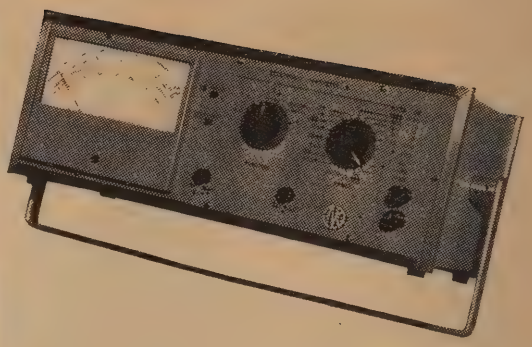


A.M.F. thermojunction ammeter in display box.

Cossor 35Mc/s transistor oscilloscope. Beam-switching is used to give two channels.







▲ *Avo electronic testmeter for R, I and V measurements.*

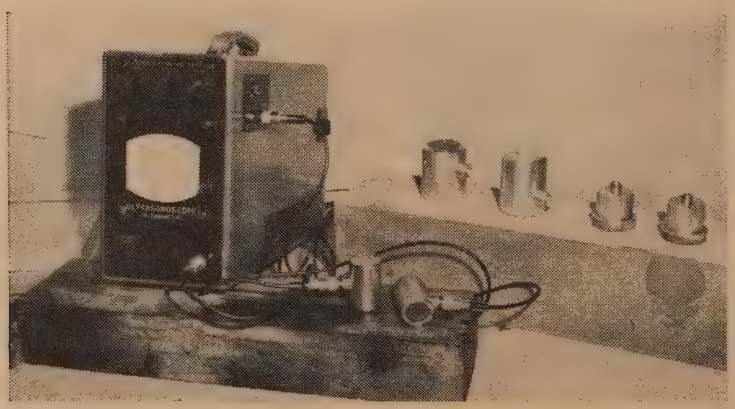
◀ *A.E.I. dielectric test set.*

tailed pair with additional negative feedback, and a dual transistor at the input for temperature stability. Negative feedback is also used in the a.c. amplifier to stabilize the meter reading. Current, voltage and resistance measurements may be made. Full-scale readings of 100 mV and 30μA are provided, and resistance is indicated between 200Ω and 20MΩ.

Material Testing:—Equipment for the determination of material parameters was displayed by A.E.I. Research and S.T.C. The dielectric loss analyser shown by A.E.I. is intended not only to assess capacitance and loss tangent but to separate solid-dielectric loss and that caused by ionization of gaseous discharges in the small cavities in the material. Advantage is taken of the fact that below a certain voltage gaseous discharges do not occur. Below this "inception voltage", capacitance and loss tangent are obtained by balancing a capacitance bridge and supply the y deflecton circuit of an oscilloscope with specimen charge storage and the x system with applied voltage. At balance, the display is a horizontal line, control settings to obtain this giving the C and loss. Above the inception voltage, the horizontal line opens out vertically to take the form of a rhomboid. The included area gives total discharge loss per cycle, height gives charge transfer per cycle, length of a horizontal the inception voltage and the projected length of the whole is the test voltage. The instrument is extremely simple to operate compared with older systems and interpretation of the result is rapid.

The S.T.C. resistivity test set is intended to measure the resistivity or the thickness of slices of semiconductor without the necessity for contacts of any kind. The principle is that of damping a tuned circuit by the resistance of the specimen. A tuned circuit is loosely coupled to a swept oscillator and the voltage across the tuned circuit at resonance measured by a peak-reading voltmeter. The slice of semiconductor is then placed in the coil and the new reading measured. Reference to a calibration chart gives specimen resistivity or, if resistivity is known, the thickness. Discontinuities in large samples can be detected. The problem of measuring the peak of an extremely narrow resonance curve is lessened by modulating the sweep speed, by means of a feedback circuit, so that the peak is broadened. Automatic level control is applied to the oscillator to keep the output constant over the 90-100 Mc/s band.

B-H Loop Plotter.—The sight of a conventional x-y plotter drawing a hysteresis loop was sufficiently interesting to cause one to dig the heels in and defy the course of enforced motion down the alleyways. Telcon Metals with the aid of this now familiar piece of equipment demonstrated their dynamic hysteresis loop plotter which was used to draw, on paper, the major and minor B-H loops of soft magnetic materials (at frequencies from 50-5,000 c/s). The method adapted is to sample simultaneously H and B waveforms over a short period of time. D.c. levels are then obtained which are fed to the x and y inputs of the plotter. The voltage signal proportional to H is obtained across a non-inductive resistor in series with the magnetizing current. The voltage signal proportional to B obtained via a search coil is integrated electronically. The signals as they now stand are easily displayed on an oscilloscope but are too fast for a plotting table. However, a sampling technique is used to supply the



Prototype ultrasonic concrete testing set Type NHM/1 shown with transmitting and receiving heads. (Ultrasonoscope Co.)

plotter drive. Pulses of 2μsec duration generated by switching a square-loop core wound with Mumetal tape are used to open a gating circuit during which the "B-H" signals are sampled. The pulse generator is triggered by a signal of the same frequency as that used in testing the core, but slowly changed in phase over a full 360°. The pen of the plotter describes a complete B-H loop. (Telcon Metals apparently do not intend to manufacture this apparatus on a commercial basis; they will, however, be pleased to pass circuit information on to would-be users.)

Compression Testing.—Ultrasonic testing of inhomogenous absorbent materials such as concrete, stone and wood was demonstrated by a prototype instrument Type NHM/1 manufactured by Ultrasonoscope. In these materials there is sometimes a correlation between the velocity of propagation of ultrasonic energy and compressive strength. The instrument has a high-power transmitter, a relatively low frequency generating and detecting system to minimize absorption in the specimen and a timing device so that the time of travel of a wave in the specimen can be measured. Transistors are used and the equipment is battery powered. The operating frequencies are 50, 100, 200 and 500 kc/s. Sweep speeds are 10μsec, 100μsec and 1msec. The sweep delay is calibrated from 0 to 10msec in 10μsec steps. The smallest resolvable time difference is 0.1μsec in any 10μsec steps up to 10msec.

Materials

The Advanced Research Group of Rolls-Royce showed examples of their current research projects on metal-coated glass fibres and fibre-reinforced metals. In association with the former case, pure fused silica had been coated with an aluminium alloy thus conferring a measure of resistance to damage to the fibres at temperatures of up to 300°C. In the case of the latter project, demonstrations showed that silica fibres continuously coated with aluminium can be compressed to form a fibre-reinforced metal. The material showed an increase in strength over ordinary aluminium at temperatures in excess of 200°C. The Research and Development Group of the Sperry Gyroscope Company showed their latest developments in the field of catalytic reduction and what is now termed "electroless" chemical plating. This enables the deposition of metal coatings on non-metallic substrates. The range of substrates now includes ceramics, ethyl silicate refractory mouldings, fused silica, resin-bonded boards and, to a more limited extent, p.t.f.e. Metals which have been found to be suited to this process are phospho-cobalt and nickel. Copper, gold, palladium, and platinum have also been deposited successfully. A layering process is possible whereby successive strata of different metals can be built up.

Though, at present, applications are somewhat obscure, the magnetic properties of an iron-rhodium alloy demonstrated by Johnson Matthey and Company were interesting enough to be noted. An alloy containing approximately equal numbers of iron and rhodium atoms was shown to have anti-ferromagnetic properties at room (and even exhibition) temperatures. However, when the alloy was heated to approximately 60°C it became noticeably ferromagnetic. Recent work indicates that the ordered structure of these alloys below the transformation temperatures changes when this temperature is reached and the magnetic and crystallographic cells coincide.

Industrial Electronics

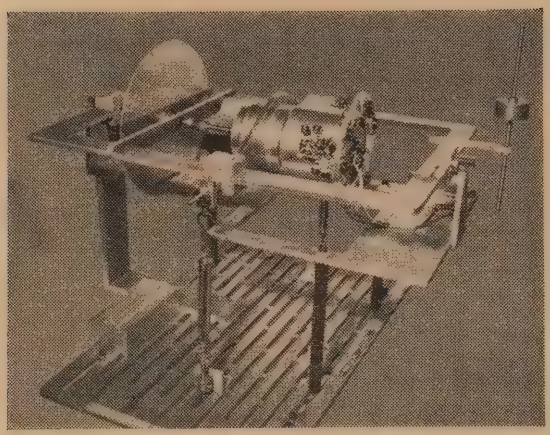
Manometry.—For the measurement of very small pressures, Mercury Electronics have introduced a micro-manometer which is sensitive down to 1mm water, and will register the pressure obtained from a pitot head at 0.1 m.p.h. The pressure capsule has an optically coated diaphragm acting as a concave mirror which varies its focal length according to the pressure inside the capsule. It is mounted in an optical system in which are two photosensitive semiconductors wired in a bridge. The output is therefore proportional to pressure over a wide range and drift is kept to less than 0.1mm water per hour.

Telemetry:—The formidable problems of measuring the blade vibrations of a power-generating turbine in the presence of copious quantities of steam, heat and centrifugal force have been solved by the Central Electricity Research Laboratories. A strain-gauge bridge is fixed to a turbine blade, its output being applied to a voltage-sensitive semiconductor capacitor, which frequency-modulates a 30Mc/s transmitter. Power is fed to the transmitter and its power circuit at 50kc/s from a stationary coil.

Communications:—For the transmission of control information and speech between a gantry crane and a fixed station, the British Iron & Steel Research Association have developed an inductive loop system. The crane carries toroidal windings through which a loop, carrying the signal, is threaded. The transmitter consists of two square-wave oscillators running at 4.8 and 5.6kc/s respectively, one frequency corresponding to a digital "ONE" and the other to a "ZERO." The oscillators are gated by a pulse train and the signal to be transmitted. Filters allow only the fundamental to be transmitted. At the receiver, the signals are separated by filters and passed to amplitude discriminators to avoid circuit noise. The signals are then detected, and passed through trigger stages to the teleprinter.

Brushless D.C. Motor:—Because of the very short life of carbon brushes when used in high-flying aircraft, it

Mercury Electronics micro-manometer.



University College of North Wales transistor-commutated motor.

was decided by the University College of North Wales that semiconductors should be suitable for use under these conditions in d.c. machines. The exhibit was a d.c. motor whose rotor is a permanent magnet, the armature being a three-coil system. A shutter is coupled to the rotor, and allows the light from a lamp to illuminate each of three phototransistors in turn. The outputs of the phototransistors are used to drive silicon transistor switches connecting each coil in turn to the supply. The efficiency is claimed to be rather better than that of the conventional brush type of motor.

Angular Measurement:—The use of optics for rotation measurement is not new, but the laser provides a means of measuring directly the rotation of a system with respect to inertial space. The ring laser designed by the Services Electronics Research Laboratory takes the form of three mirrors arranged on a ring, with a gas discharge tube between each pair of mirrors, the whole forming a triangle. Transitions in the gas atoms in the tubes provide sufficient gain to overcome losses in the optical system, and oscillation takes place, the wavelength being 6328Å. No preferred direction of propagation is inherent, and two contra-rotating oscillations are produced. If the ring is stationary, the oscillation wavelengths are identical, but if the ring rotates with respect to space, the oscillation propagated in the same direction as the ring rotation needs a longer wavelength to keep the propagation path a whole number, and the frequency of oscillation decreases. The opposite state of affairs exists for propagation in the other direction. If samples of the two frequencies are applied to a photodetector, the beat note is a measure of rotation rate. The rotation of the earth should in theory give a beat of 46c/s, but the two oscillations tend to pull one another, and this small difference is not measurable. The system has possibilities in inertial navigation.

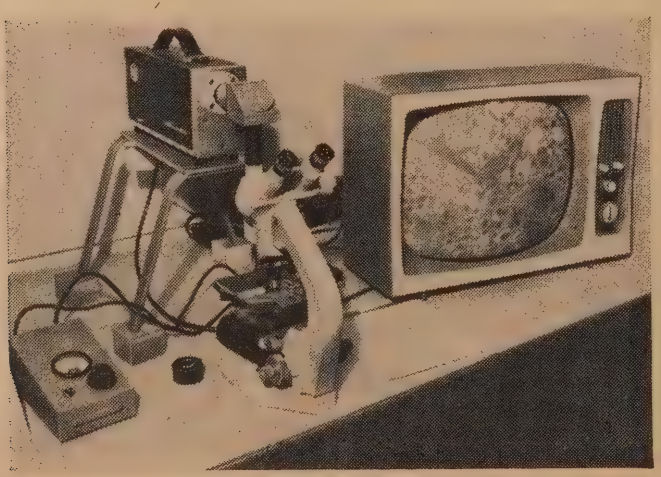
Television Microscope:—The Watson television eyepiece with pointer enables a horizontally-positioned camera to be used in conjunction with any microscope. The pointer, whose controls are on the eyepiece, can be brought into sharp focus on the monitor screen and ranged freely over the entire field of view. When used with a binocular microscope the television eyepiece is fitted over one of the optical eyepieces, allowing the other eyepiece to be used conventionally. At the exhibition a trinocular microscope was used so that binocular and monitor vision of the specimen was possible simultaneously. The magnification on the monitor screen is determined by the magnification factor of the objective in use × 1.25 × screen diagonal (when screen diagonal is measured in inches).

Semiconductors

Light.—It took many people long enough to accept the concept of holes moving about in a piece of semiconductor, but it would now appear that photons are the latest thing in current carriers. Mullard had a device called the transluxor, which is a light-operated amplifier. A gallium arsenide diode is biased into its forward region and emits light at about 9100Å at room temperature or, considerably more efficiently, at 77°K. The input current produces the light, which is transmitted at its customary high velocity (no transit-time effects) to a p-n junction between gallium arsenide and another unspecified material. Current gain between input and output approaches unity. The responses of emitter and collector to current and light stimuli are such that light modulation of the order of 1Gc/s is expected to be possible.

A gallium arsenide emitter shown by Mining and Chemical Products produces infra-red radiation at a wavelength of about 9000Å. Typically, the diode requires between 50 and 400mA at about 1.25V to produce up to 15μW of infra-red power. Greater output for the same current can be obtained by cooling the emitter to 77°K, the temperature of liquid nitrogen.

Gallium phosphide is used in a similar device shown by the Services Electronic Research Laboratory. Depending on the material used to dope the GaAs, the colour of the light is either green or red, and others are possible. The response time of the device is of the order of 0·2μsec. Drive conditions are 25mA at 2V to give between 10 and 40 foot-lamberts. If the drive is applied in short pulses, very bright flashes of light can be obtained.

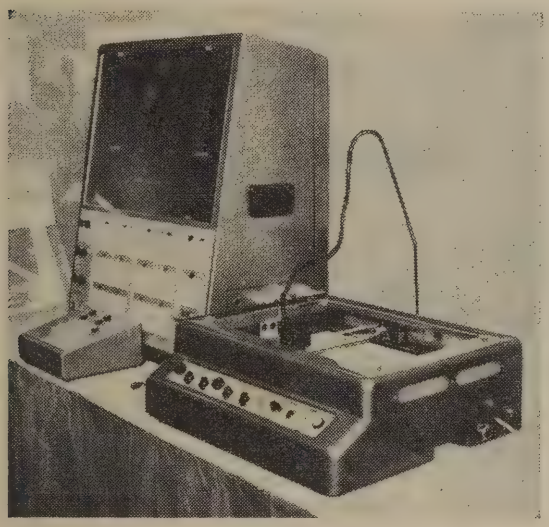


Watson television camera microscope eyepiece used with a trinocular microscope.

Computers and Data Processing

Recent developments in the computer and data processing fields, if this year's exhibition was to be taken as indicative of trends, showed a leaning towards a speeding up of data processing.

Bryans presented a formidable display with their Series 20017 digital data translator. Essentially the equipment is a digital-to-analogue converter which selects and processes data representing the x and y coordinates of a graph from digital data on punched cards or tape and converts them to analogue form suitable for feeding into an x-y plotter. Transistors are used throughout the equipment. A keyboard is also provided



Bryans digital data translator.

for testing or for keying-in additional data. A large neon display panel allows visual input checking of polarity, numeric value and channel number.

The Admiralty Research Laboratories demonstrated a new voltage digital recorder, designed to record a transient voltage signal by sampling at a high rate, converting to digital form and recording on magnetic tape. On replaying the tape the information is transferred to 5-hole paper tape for subsequent processing by computer. Compared with the conventional system of photographing an oscilloscope trace to record a transient signal this method, though costing more, represents a considerable saving of time.

An analogue-to-digital converter demonstrated by J. Langham Thompson changes analogue input voltages between 0 and 10 volts to an equivalent binary digital output suitable for feeding to a paper-tape punch machine or directly to a computer. The converter, which has an input impedance of 100kΩ, is triggered by a 10V positive-going pulse so that the input voltage can be converted to a digital output at any given instant. Thus, with a suitable pulse generator the converter can be used to produce digital outputs corresponding to the input voltage at regular time intervals.

The Data Processing Research Laboratories of Elliott-Automation gave a foretaste of things to come by showing units of a prototype tunnel-diode digital computer based on Goto-pair logic. The computer uses a 3μsec cycle store time and a 40-digit word length. Electromagnetic delay lines are used for serial storage while conventional ferrite cores are used as a parallel bulk storage medium.

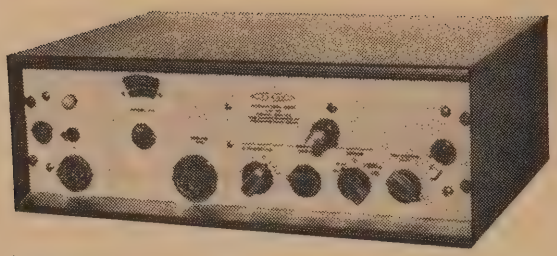
Microwaves

Many difficulties in variable-tuned circuit design at u.h.f. are associated with variable capacitors. The use of a variable inductor often provides a solution. One possibility is the use of an inductor with a saturated core. A ferrite variable inductor working up to about 800Mc/s was demonstrated by the Caswell Research Laboratories of the Plessey Company. It consisted of a coil wound across the diameter of a soft ferrite disc about which a saturating static field, parallel to the plane of the disc, can be rotated. When the static field and the alternating field generated in the coil are parallel the permeability is unity but when they are perpendicular a permeability of approximately four may be obtained. The losses are reasonably low, and in practice a Q of between 50 and 75 has been achieved in a circuit with a tuning range of 275 to 390Mc/s.

Flann Microwave Instruments demonstrated a new microwave oscillator Type PCLX which covered the range 4 to 12Gc/s. The instrument uses a plug-in klystron valve in a coaxial line cavity and the reflector voltage is automatically adjusted for the frequency of operation. Frequency is shown on a direct-reading dial and since the load conditions can pull the frequency and invalidate the critical reflector potential derived by the tracking system, a trimming potentiometer allows a small measure of readjustment. Over the frequency range the maximum power available varies from 4 to 100mW. The levels are adjustable by withdrawing the coupling probe into the cut-off tube. The output impedance is 50Ω. A transistor power supply drives both the klystron oscillator and the modulator circuits. Square-wave or sawtooth modulation can be applied.

When the applications to which lasers can be put are considered it was surprising that so few lasers were ex-

Typical of the interest shown in exhibits in the Educational Section.



Klystron oscillator for 4 to 12 Gc/s manufactured by Flann Microwave Instruments.

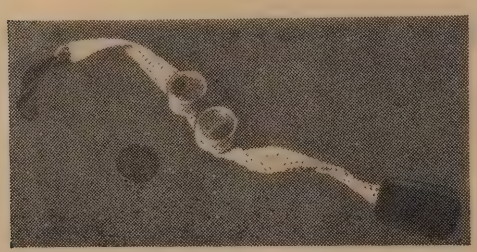
hibited. Some three gas and one ruby laser were demonstrated at the exhibition together with a few applications. Elliott-Automation in their educational display demonstrated a bench-mounted helium neon laser. With this equipment the use of confocal mirrors external to the tube simplifies alignment and the change-over from infra-red to visible operation was easily performed. Other demonstrations in this field included rotation measurement (described elsewhere in this report), micro-welding by ruby laser devices and Raman spectroscopy.

Miscellaneous Exhibits

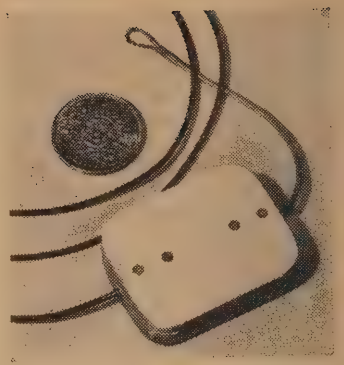
Delay line: A parametric delay line designed by University College of North Wales uses back-biased junction diodes as the capacitive elements. The velocity of propagation along the line, and therefore delay, is variable by altering the diode bias. If this is done while a pulse is in transit along the line, stretching or compression of the pulse is obtained, the frequency components of the pulse being scaled up or down.

Medical Electronics: Many stands showed that medical physics and electronics had not stood still over the past year. The miniature radiotelemetering device for cardiac monitoring shown by the University of Edinburgh and the South-Eastern Regional Hospital Board was inconspicuously conspicuous by the degree of miniaturization attained when one considered that the battery which was contained in the apparatus gave a working life of 250 hours. The equipment consisted of a metal reed tuned to about 180c/s (which is found to be the optimum frequency) and forming one plate of a tuning capacitor of a one-transistor v.h.f./f.m. transmitter. Impulses causing vibration of the reed therefore result in the modulation of the frequency of the transmitter. No electrodes are needed, and by strapping the monitor on the chest a clear indication of heartbeats can be heard remotely from the patient.

The St. George's implantable pacemaker Mk. II



V.h.f./f.m. cardiac monitor and battery case developed by the Department of Medical Physics, Royal Infirmary, Edinburgh (compared with a 3d piece).



Devices pacemaker Mk II shown with a florin for size comparison. Major chest surgery is avoided.

manufactured by Devices was an interesting development of an established technology in that the need for major surgery has been avoided. The pacemaker, consisting of a two transistor and a diode conventional blocking oscillator together with four Mallory batteries, is enclosed in a silicone-rubber case. This is implanted subcutaneously in the armpit region. The platinum-tipped electrodes are taken to the heart via the jugular vein. A 1msec pulse 5V in amplitude is produced and is then differentiated to minimize polarization and hence corrosion, of the electrodes. The pulse repetition rate is variable for use in patients of widely differing age groups.

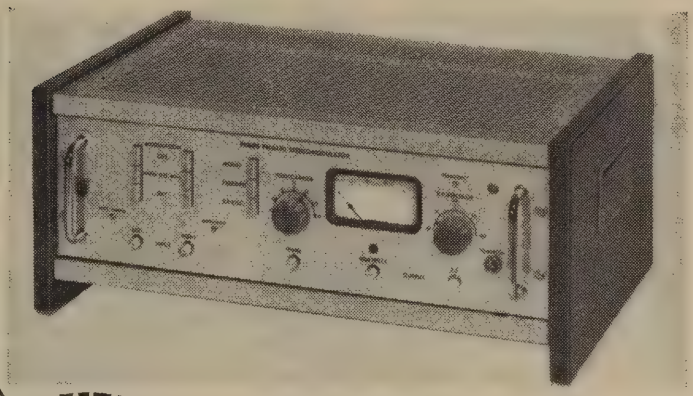
Radio Microphone: A complete radio microphone system was shown by Labgear of Cambridge. The system has an audio-frequency response of 50 c/s to 12 kc/s ±2 dB and although the receiver unit has a mains power supply, provision is made for battery operation. The transmitter, which is frequency modulated, has an output power of 50 mW. The spurious radiation level is less than 100 μW. Power is provided by an internal rechargeable nickel-cadmium cell. The frequency stability is within ±5 kc/s of the nominal carrier frequency. The receiver provides an output of 1V into 600Ω and has a frequency range of 174.6 to 175 Mc/s. A special feature of the receiver is the provision of a battery charger output for recharging the transmitter battery.

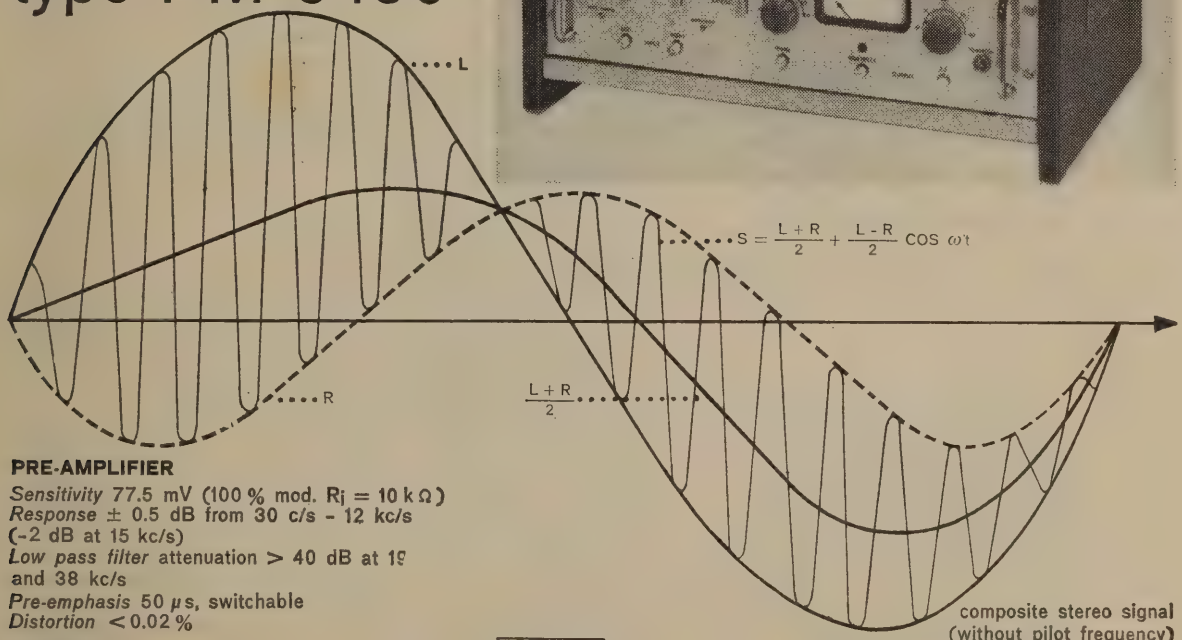
Stabilizer: When the input voltage to a series regulator is varied over a wide range, trouble can be experienced due to excessive power dissipation in the series transistor. To avoid having up to three power transistors in parallel, Transitron Electronics employ a silicon planar type to pre-stabilize the supply to the series regulator. A free-running multivibrator is fed from the pre-stabilized supply, the square-wave output being fed back to a 2N1722 chopper transistor, which features 0.15Ω saturation resistance and a cut-off frequency of 20 Mc/s. The feedback loop tends to keep the voltage across the series regulator constant and reduces the power dissipation.

Combination Lock: Purely for amusement, A.E.I. invited clearer-minded visitors to try to operate their electronic combination lock. A deceptively simple block diagram was displayed behind the lock, but, in our case, to no avail. The lock could be operated by switching the inputs to a series of AND gates, the outputs of which were fed back in a devious way. The reward for success was the lighting of a lamp, which seemed a bit miserly.

Built-in FM signal generator
Direct L and R inputs
Separate 19 kc/s pilot signal
Composite signal and modulated RF output
Internal 400 c/s and 1000 c/s oscillators
Peak-reading modulation meter
Built-in 50 μs pre-emphasis network
Fully transistorised
In accordance with FCC system

new FM stereo modulator, type PM 6450





composite stereo signal (without pilot frequency)

PRE-AMPLIFIER
Sensitivity 77.5 mV (100 % mod. $R_i = 10\,k\Omega$)
Response ± 0.5 dB from 30 c/s - 12 kc/s (-2 dB at 15 kc/s)
Low pass filter attenuation > 40 dB at 19 and 38 kc/s
Pre-emphasis 50 μs, switchable
Distortion < 0.02 %

MODULATOR
Sub-carrier 38 kc/s (± 3 c/s)
Pilot carrier amplitude 0, 3, 6, 9, 12, 15, 18 % ± 3 %; phase accuracy ± 1°
Cross-talk > 40 dB from 30 c/s - 15 kc/s
Carrier suppression > 40 dB

OUTPUT AMPLIFIER
Response ± 0.1 dB from 30 c/s - 53 c/s
Output voltage 4.36 V_{pp}

RF GENERATOR
Frequency 100 Mc/s ± 1 Mc/s
Output voltage V_o max. > 200 mV, V_o min. < 20 μV

PHILIPS

PHILIPS

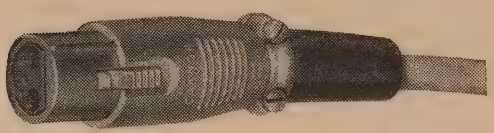
electronic measuring instruments

Sales and Service all over the world
Sole distributor for the U.K.:
Research and Control Instruments Ltd., 207 Kings Cross Road, LONDON WC1
For the Republic of Ireland:
Philips Electrical (Ireland) Ltd., Newstead, Clonskeagh, DUBLIN
Overseas enquiries please, to the manufacturers,
Philips, Ema Department, EINDHOVEN, Holland

5WW—095 FOR FURTHER DETAILS.

NUMBER ONE IN ELECTRICAL CONNECTORS... 1

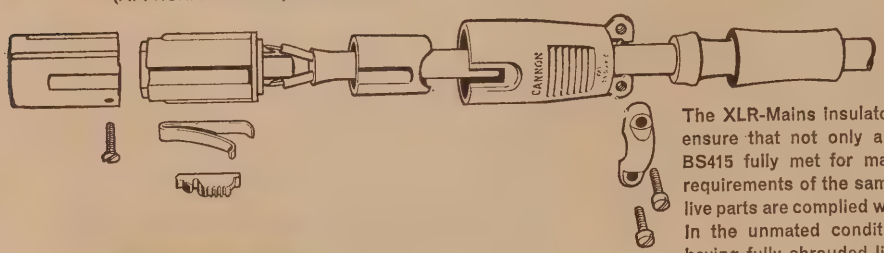
NEW XLR MAINS CONNECTOR



(APPROX. FULL SIZE)

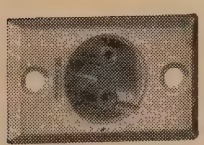
New versatility

Cannon has developed a mains version of the already well established range of high quality audio XLR connectors with latch/lock coupling. This will permit the standardisation by equipment manufacturers and users, of a common type of connector which covers both audio and mains input applications. The XLR-Mains is suitable for cable rated at 2 amps and fully meets the Safety Requirements of BS415. The XLR mains was designed at the specific request of the BBC.

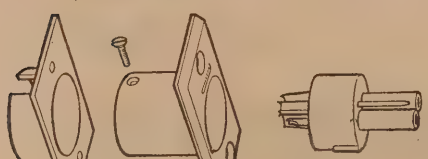


The XLR-Mains insulator has been carefully designed to ensure that not only are the creepage requirements of BS415 fully met for mains voltages but that the safety requirements of the same Specification limiting access to live parts are complied with by *both* halves of the connector in the unmated condition. This has been achieved by having fully shrouded line and neutral socket contacts in the receptacle insert and deeply recessed and shrouded corresponding pins in the plug. The earthing connection is made by a pin contact in the receptacle and by a socket contact in the plug; both the earth contacts are connected directly to the outer shell. By having both pin and socket contacts in each half of the connector and by the shrouding given to the line and neutral contacts, mismating of the mains version with any of the audio versions is prevented. In addition, to provide immediate visual discrimination between the XLR Mains and the XLR Audio series, in both the unmated and mated condition, the insert mouldings and cable bushing of the mains connector are coloured red.

An insulating shroud is available for the XLR-LNE-32 fixed receptacle. This permits electrical isolation of the metal receptacle body from the panel when the prevention of earth loops is desirable. The XLR-LNE connector is fitted with the latch/lock type coupling which is standard on the XLR range.



(APPROX. FULL SIZE)



For any connector requirement consult the world's most foremost name in this highly specialised field.

"CANNON" IS A TRADEMARK REGISTERED IN U.S. PATENT OFFICE AND IN OTHER COUNTRIES BY CANNON ELECTRIC COMPANY

CANNON ELECTRIC (GREAT BRITAIN) LTD.

168 Old Street, London E.C.1, England

PLANTS IN: LONDON • BORNEM, BELGIUM • PARIS • TOKYO • MELBOURNE • TORONTO
LOS ANGELES, SANTA ANA & ANAHEIM, CALIF. • PHOENIX, ARIZ. • SALEM, MASS.

Sales offices and representatives in principal cities of the world

CANNON® PLUGS

CANNON ELECTRIC

© 1963 CANNON ELECTRIC COMPANY

European Enquiries: Cannon Electric International Inc., Bornem, Belgium. Telephone: (03) 77.06.14.
Scandinavian Enquiries: Sweden: Ab Gosta Backstrom, Box 12039 Stockholm 12. Denmark: Tage Schouboe, 7 Skyttegade, Copenhagen. Norway: Morgenstierne & Co., Wessels Gate 6, Oslo. Finland: OY Chester AB, Uudenmaankatu, 23.A, Helsinki.

5WW—096 **FOR FURTHER DETAILS.**

MANUFACTURERS' PRODUCTS

NEW ELECTRONIC EQUIPMENT AND ACCESSORIES

Voltage Stabilizer

A TOTALLY enclosed, mains voltage stabilizer, Type 126 produced by Servomex Controls, Crowborough, Sussex, has been designed to meet severe environmental conditions. Enclosed in a heavy-gauge mild-steel case without orifices, the equipment can be used in excessively dusty and damp atmospheres. It will withstand shocks of up to 40g and can be immersed in up to 18in of water (from its base).

The input voltage is within the range 200 to 250V. The correction range with an output of 7kVA is −20% to +10% or −15% to +15%. At 14kVA the correction ranges are −10% to +5% or −7½% to +7½%. The harmonic distortion introduced is claimed to be negligible. The case is mounted on castors and the top cover is easily removed for servicing.

5WW 311 for further details

Wide-range Signal Generator

TWO attenuators, 50Ω and 600Ω are provided in the E.H. Research Laboratories signal generator Model 410. The 50Ω control provides 50dB attenuation in 10dB steps. Together with the amplitude control, the output, over the whole frequency range of 10 c/s to 10 Mc/s, is variable from 3 V to 3 mV into 50Ω. The 600Ω attenuator provides up to 50dB attenuation also in 10dB steps and it is calibrated in volts and dBm. With the amplitude control the output voltage can be varied continuously from 1.5 V to 1 mV. Both attenuators are accurate to within ±1dB.

When correctly terminated the output from the instrument is level to within ±0.5dB from 10 c/s to 1 Mc/s and ±1 dB from 1 Mc/s to 10 Mc/s. The long-term frequency stability is within ±1% after a warm-up time of 15min. The output can be taken via a type B.N.C. coaxial connector or from a pair of screw terminals. The output level is monitored on a voltmeter calibrated in volts and dBm. The reading when the instrument is correctly terminated is accurate to within ±5% of full scale. The distortion is claimed to be less than 1% from 20 c/s to 100 kc/s, less than 2% from 100 kc/s to 1 Mc/s and better than 3% from 1 to 10 Mc/s.

Rack-mounting and bench versions can be obtained at £226 and £234 respectively (exclusive of duty) from Livingston Laboratories, Camden Road, London, N.W.1.

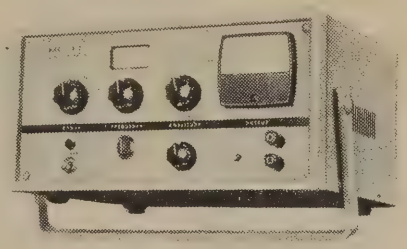
5WW 312 for further details

Battery-powered Millivoltmeter

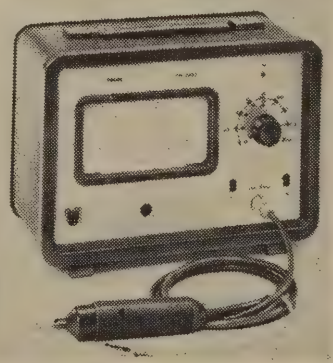
EIGHT voltage ranges, with a minimum full scale deflection of 1mV and a maximum f.s.d. of 3V, are provided by the PM2453 millivoltmeter recently introduced by Philips and available in the U.K. from Research and Control Instruments Ltd., King's Cross Road, London, W.C.1. The accuracy of measurement is within 5% over the frequency range 50 c/s to 1Mc/s. Over the range 10c/s to 5Mc/s the accuracy is reduced to within 9%. With the attenuator probe, which is supplied with the voltmeter, the measurement range can be extended to 300V.

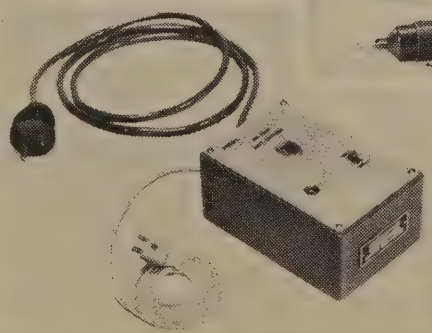
Powered by five rechargeable batteries and weighing 4½lb, the instrument is usable at all times. The batteries may be recharged 300 times

▲ *Voltage stabilizer Type 126 manufactured by Servomex Controls.*



▲ *E-H Model 410 wide-range signal generator.*





▲

◀ *Type PM2453 transistor battery-powered millivoltmeter shown with the battery charger PM9000. Both equipments are manufactured by Philips.*

and provide 40 hours operation per charge. The millivoltmeter has a battery self-check facility. An accessory, a battery charger Type PM9000, is available for recharging the batteries from a mains supply without the need for their removal from the instrument.

The input impedance of the instrument is 1MΩ in parallel with 35pF. An internal oscillator provides a 10kc/s calibrating signal. The cost of the instrument is £70.

5WW 313 for further details

Silicon Rectifier and Heat Sink

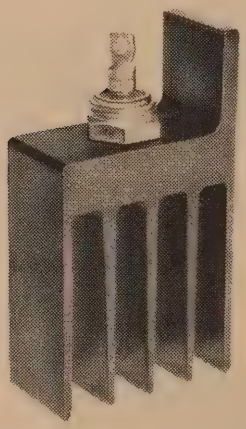
INTERNATIONAL Rectifier announce a new range of silicon rectifiers rated at 60A with stud temperatures of 115°C. Components from this new 25G range are available over a wide voltage range and the maximum pulse overload is 850A for 10msec. The rectifiers are made with a welded glass-to-metal seal and are tin plated. An alloy-extruded heat sink has been developed by the International Rectifier Co. of Oxted, Surrey, for use with this series of rectifiers.

5WW 314 for further details

Wobbulator

TELEVISION Bands IV and V are covered by the Metrix u.h.f. wobbulator Type 240. The frequency range of this instrument extends from 470 to 870 Mc/s (channels 21 to 68) and over this range the wobbulator can be used as a "single-signal" generator. When used as a sweep generator the sweep can be varied continuously from less than 2% of the centre frequency up to 23 Mc/s (±11.5 Mc/s) at a repetition frequency of 50 c/s. The maximum output level is 1V peak to peak at an impedance of 50 ohms. Internal markers are provided and these have a rectangular wave shape. A horizontal sweep output (for oscilloscope applications) 10V in amplitude at 50 c/s is available variable in phase through 120°. The wobbulator can be powered from a 115 to 250V 50 c/s mains supply. Costing £296 approximately it is obtainable in the U.K. from Bemax Instruments Ltd., 54 Victoria Road, Surbiton, Surrey.

5WW 315 for further details



▲ *International Rectifier Type 25G rectifier mounted on a Type E heat sink.*

▲ *24-channel Visicorder Oscillograph manufactured by Honeywell Controls.*

Recording Oscillograph

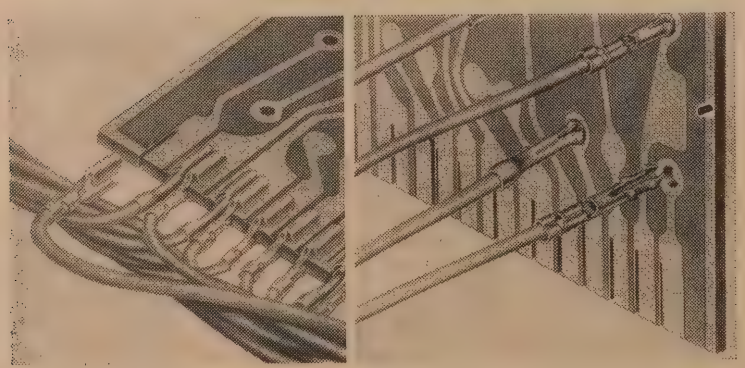
TWENTY four channels are provided on an 8-in wide paper by the Model 1508 Visicorder Oscillograph manufactured by Honeywell Controls, Greenford, Middlesex. Each channel can record at frequencies ranging from z.f. to 5kc/s. All operating controls are on the front panel of the instrument, which is only 7in high. Any of 12 recording speeds may be selected before or during recording by pushbutton control. Deflections of 8in peak to peak are possible and traces are recorded at writing speeds in excess of 125 cm/msec. The recorder's optical system, magnet assemblies and drive systems are mounted on a single metal casting. The main light source is a high-pressure mercury vapour lamp. A number of accessories are also available. Rack or bench mountable, the instrument weighs approximately 50lb.

5WW 316 for further details

Printed-board Terminals

TWO PRODUCTS introduced recently by Aircraft Marine Products facilitate connections to printed-board circuitry. The AMP-EDGE terminal provides a simple connection using slots cut into the edge of either single- or double-sided circuit boards. The AMP-IN terminal enables lead connection to any point on a printed board. It consists of a tubular jack with a shoulder which fits into a hole 0.072in diameter. The connecting wires to both types of terminal can be machine or hand crimped. The address of the manufacturer is 87-89 Saffron Hill, London, E.C.1.

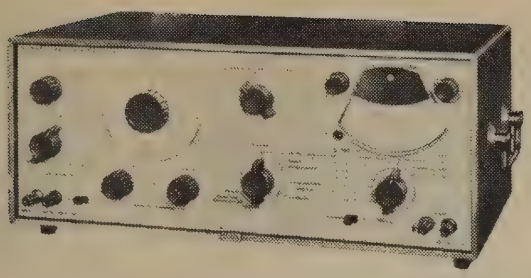
5WW 317 for further details



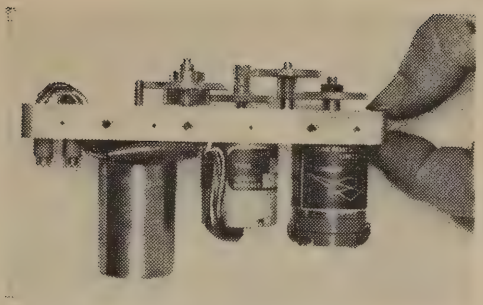
▲ *AMP-EDGE and AMP-IN printed board terminals manufactured by Aircraft-Marine Products.*

Distortion Factor Meter

A NOTABLE feature of the new distortion factor meter Type TF 2331, manufactured by Marconi Instruments, is that the fundamental frequency-rejection filter is tuned by a calibrated dial with fine control so that almost complete fundamental rejection can be obtained over a frequency range of 20 c/s to 20 kc/s. Transistors are used throughout the instrument, which is normally powered by an alternating mains supply, but provision is made for

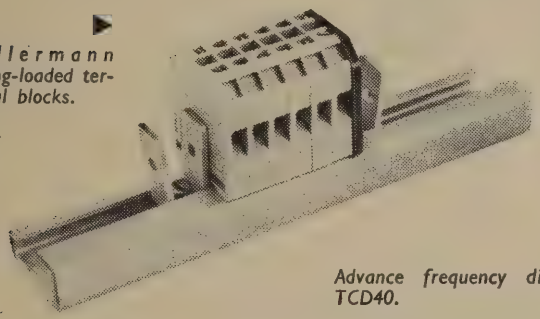


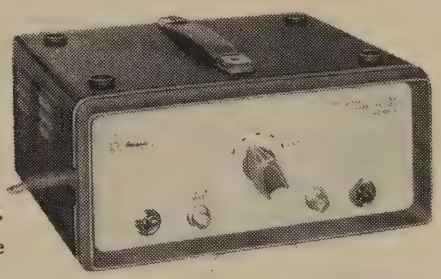
▲ *Marconi Instruments distortion factor meter Type TF 2331.*



▲ *Moore Reed analogue-to-digital converter designed to meet the requirements of M.o.A. Av. P.24*

▶ *Hellermann spring-loaded terminal blocks.*





▶ *Advance frequency divider Type TCD40.*

battery supply. Distortion measurements down to a factor of 0.05% may be made over an input voltage range of 0.775V to 30V (r.m.s.) The internal voltmeter, besides being used for d.f. measurements, can be used for voltage measurements over the range 1mV to 30V and up to a frequency of 100 kc/s. The input resistance can be switched from a 600-Ω resistance to a high-impedance input. Other facilities include an l.f. cut for the elimination, if required, of mains hum and an amplifier output from the voltmeter section for oscilloscope examination of the signal. The instrument weighs 15lb and is available in bench or rack-mounting versions.

5WW 318 for further details

Terminal Blocks

A SPRING-LOADED terminal block that permits the use of 46 terminals per foot is available from Hellermann Terminals, Crawley, Sussex. The terminals are mounted in a rail and are locked with screws. The blocks are manufactured from Melamine and are rated at 25A, 230V.

5WW 319 for further details

Frequency Divider

THE range of existing 1 and 10Mc/s counters may be extended by the use of the Model TCD40 frequency divider manufactured by Advance Components Ltd., Hainault, Essex. Operating over the range 1 to 40 Mc/s, division factors of 100, 40, 10 and 4 may be selected. When frequency division is not required a direct connection of input to output can be made. Both input and output sockets are 50-Ω BNC types. The maximum input sensitivity is 50 mV r.m.s. The output pulses provided by the unit are greater than 2V peak-to-peak. The divider can be used over the temperature range 0 to 40°C and a 45 to 65 c/s mains supply is required.

5WW 320 for further details

Switching Diode

A HIGH-SPEED, planar epitaxial diode, designated the Type ZS142 is available from Ferranti Ltd., of Hollinwood, Lancs. The component was developed principally for computer applications and at an ambient temperature of 25°C is rated at a maximum peak inverse voltage of 25V. The maximum power dissipation is 275mW. At 1Mc/s the capacitance at 1V is 1.4pF and at 10V, 1.25pF. The length of the diode is 0.300in and the diameter is 0.106in. Connections are made by flexible leads.

5WW 321 for further details

Analogue-to-Digital Converter

AN analogue-to-digital converter system comprising a 6-pole, 400 c/s servo motor, a gear train driving a digital shaft encoder and a high-accuracy control transformer synchro having a maximum error of

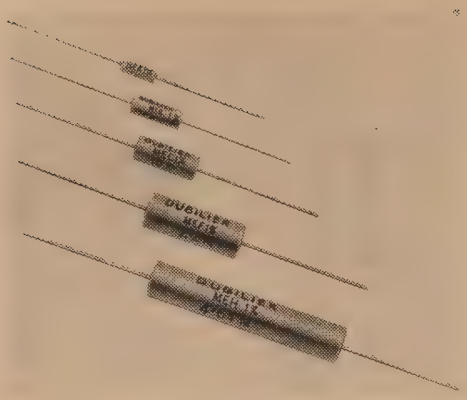
INFORMATION SERVICE FOR PROFESSIONAL READERS

To expedite requests for further information on products appearing in the editorial and advertisement pages of *Wireless World* each month, a sheet of reader service cards is included in this issue. The cards will be found between advertisement pages 40 and 43.

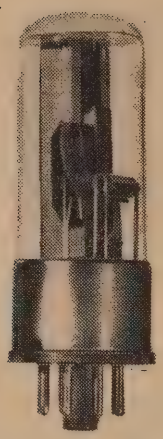
We invite readers to make use of these cards for all inquiries dealing with specific products. Many editorial items and all advertisements are coded with a number, prefixed by 5WW, and it is then necessary only to enter the number(s) on the card.

Readers will appreciate the advantage of being able to fold out the sheet of cards, enabling them to make entries while studying the editorial and advertisement pages.

Postage is free in the U.K., but cards must be stamped if posted overseas. This service will enable professional readers to obtain the additional information they require quickly and easily.



▲ *Components from the Dubilier ME range of metal film resistors.*



▲ *Thermal-delay switch Type S45 C/ID manufactured by Standard Telephones and Cables.*

▲ *"Micro-6" radio receiver distributed in kit form by Sinclair Radionics.*

▲ *"Lan-Dec" Type L.D.-15 digital computer designed primarily for educational establishments.*

±3 minutes has been introduced by Moore, Reed and Company, Durnsford Road, London, S.W.19. It accepts a standard control-transmitter synchro-output signal for conversion into digital form. The system provides a digital readout in Gray code at a resolution of 2^{11} or 2^{12} per revolution of the synchro shaft or up to 2^{12} in a binary code. The synchro rotates at 20 r.p.m. at full motor voltage. Measuring $1\frac{7}{16} \times 3\frac{1}{16} \times 5$in the unit fits into a standard ARINC case.

5WW 322 for further details

Metal Film Resistors

THE Dubilier Condenser Company announce that metal film resistors designated ME Types are available in five wattage ratings and resistance values from 30Ω to 10MΩ. The standard tolerance is ±1% but tolerances of 0.5, 0.25 and 0.15% can be obtained dependent upon temperature coefficient.

The outer casing for the lower wattage sizes is a moulding of moisture-resistant, high-temperature plastic material and for the 1 and 2 watt components, a porcelain tube with hermetically sealed ends. All five sizes have low noise levels which are independent of the resistance values. The level is normally less than 0.1μV/V. The voltage coefficient measured between one-tenth and full-rated voltage is less than 5 p.p.m./V for all values. However, on low and medium value resistors the voltage coefficient is essentially zero. Resistors from the ME series can be supplied in five different temperature coefficients from ±150 parts per million/°C down to ±15 parts per million/°C. They are non-inductive up to approximately 100Mc/s excepting for the low-value, high-wattage types.

5WW 323 for further details

Miniature Radio Receiver

A SIX-STAGE transistor radio receiver measuring $1\frac{4}{8} \times 1\frac{3}{16} \times \frac{1}{2}$in, is available from Sinclair Radionics, Histon Road, Cambridge. Designated the Micro-Six it contains an internal ferrite-rod aerial and operates in the medium waveband. A.g.c. is applied to the r.f. stage and negative feedback to the a.f. stages. The receiver is powered by a mercury cell. All parts, including an earpiece, are available at a cost of 59s 6d.

5WW 324 for further details

Thermal-delay Switch

ALTERNATING currents of up to 5A at 250V can be switched by the Type S45 C/ID thermal-delay switch manufactured by S.T.C. Valve Division, Footscray, Kent. The switch is a single-pole, change-over device with a nominal delay time of 42 sec.

5WW 325 for further details

Educational Digital Computer

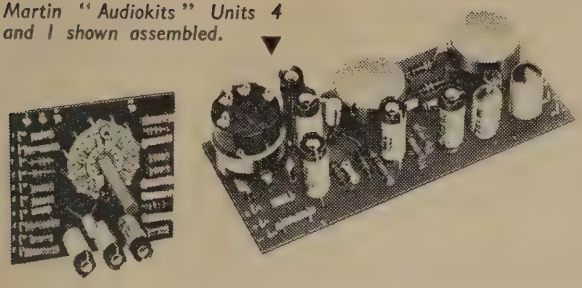
MANY digital computer applications can be demonstrated with the "Lan-Dec" digital computer manufactured by Lan-Electronics Ltd., Farnham Road, Slough, Bucks. The "Lan-Dec" is basically a large patch board with standard computer logic symbols representing each of the 15 NOR gate transistor logic circuits which are wired directly to the underside in five vertical columns of three gates each. Connections to each of the NOR gates are duplicated. Demonstrations possible include Boolean algebra, half and full adders, subtraction and shift registers and binary counters. Each instrument is supplied with the cords necessary for patching and a comprehensive instruction manual. The current consumption of the equipment is 300 mA. A low-voltage power supply which is capable of powering two "Lan-Dec" computers is also available.

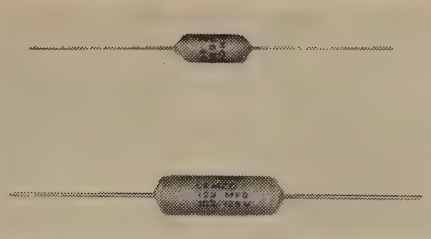
5WW 326 for further details

Audio Construction Kits

TRANSISTOR audio kits manufactured by Martin Electronics of Brentford, Middlesex, are so designed that further units can be added at any time to increase the scope of the equipment without replacing existing units. All the units of the series are on printed boards and transistors are used throughout the range. The main amplifier, designated Unit 5, is available as a 3W or 10W version and the sensitivities of both versions enable them to be matched to the outputs of Unit 2 (pre-amplifier with volume control) or Unit 4 (combined pre-amplifier

Martin "Audiokits" Units 4 and 1 shown assembled.





▲ Capacitors from the Lemco polyester range.

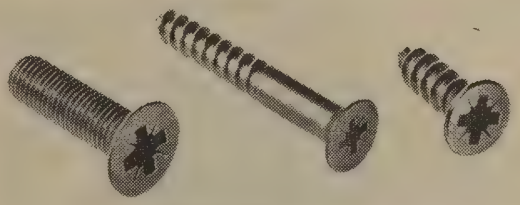
and tone control unit). The main amplifier has a transformerless 3-Ω output stage. Unit 1 is a 5-input, matching selector unit. Unit 2, the pre-amplifier, is claimed to have a frequency response of 45c/s to 20kc/s ±2dB and a harmonic distortion of 0.25% at 10W output when used with other units of the series. Unit 3 is a 3-channel mixer unit, the versatility of which is increased by the availability of plug-in adaptors to enable the unit to be used with a variety of audio transducers. The combined pre-amplifier and tone-control unit (No. 4) has a base control operating over the range −16 to +10dB and a treble control from −16 to +12dB. A power supply unit is available with 24V output, tapped for supplies to the units. Front panels are available for all the units with controls. Unit 1 kit costs 47s 6d, Unit 2—37s 6d, Unit 3—79s 6d, Unit 4—62s 6d and Unit 5, which is based on the Mullard AB transformerless design, £5 12s 6d. The power supply costs 52s 6d.

5WW 327 for further details

Television-signal Pre-amplifier

A NUMBER of television-signal pre-amplifiers are available from Gordon J. King of Brixham, Devon. The equipments amplify Band I and Band III frequencies and switching from one channel to the other on the pre-amplifier is unnecessary. Power is provided by a 9V battery contained within the case and the only connections necessary are from the aerial to the pre-amplifier and from the pre-amplifier to the television set: both input and output impedances are 75Ω. A v.h.f./f.m. version is available. The television units are designated "Telebooster" and the f.m. version F.m.-booster. The voltage gains of the former pre-amplifiers are 18dB for the channel tuned to in Band I and 14dB for the channel tuned in Band III. The f.m. version has a 16dB gain over a group of 3 to 4 channels. The bandwidth of the "Telebooster" is quoted as being approximately 1.5dB down on the channels adjacent to that tuned. The dimensions are $3\frac{1}{2}\times 3\frac{1}{2}\times 2$in and the weight $\frac{1}{2}$lb (including battery). The cost of each amplifier is 75s 6d.

5WW 328 for further details.



◀ "Pozidriv" recessed-head screws.

Polyester Capacitors

THIRTY standard values of capacitance are available in a new range of polyester capacitors manufactured by the London Electrical Manufacturing Company. Values range from 0.01μF to 1μF (125V working) and 0.001μF to 0.47μF (400V working). The capacitance tolerance is within ±10% of all values and the power factor at 1kc/s is better than 60×10^{-4}. The components may be used over a temperature range of −40 to 100°C. The dimensions vary from 7mm diameter and 21mm length to 19.5mm diameter and 35mm length. The London Electrical Manufacturing Company, Bridges Place, Parsons Green Lane, London, S.W.6, now produce ceramic, mica, polystyrene, electrolytic and polyester capacitors.

5WW 329 for further details

Improved "Phillips" Screws

DESIGNED to reduce assembling times and to lengthen the life of power screwdriver bits, the new "Pozidriv" recessed head announced by G.K.N. Screws & Fasteners Ltd. is based on the well-known Phillips cruciform slotted head, but has nearly parallel driving faces which eliminate the "lift" experienced when driving the original type. The difficulties experienced earlier in producing economically the ideal slot have now been overcome and machine, self-tapping and wood screws in a wide range are now available to industry. Retail sales are promised for the autumn.

Complementary screwdrivers and bits for power tools will be available from Stanley Works (Great Britain) Ltd.

5WW 330 for further details

Stereo Cartridge

A CERAMIC, stereo cartridge introduced recently by The Goldring Manufacturing Company of Leytonstone, London, E.11, has a frequency response which extends from 30c/s to 20kc/s. The output is 50mV per channel (1kc/s) and the signal to cross talk ratio is specified as −20dB at 1kc/s and −10dB at 10kc/s. A replaceable diamond stylus is provided with a tip radius of 0.005in. The cartridge can be tracked at 2gm, the lateral compliance being 10×10^{-6} cm/dyne and the vertical 8×10^{-6} cm/dyne. The recommended load impedance is from 1 to 2MΩ. The cartridge, including purchase tax, costs £4 17s 8d.

5WW 331 for further details

Transistor Pads

NYLON transistor mounting pads, suitable for use with both TO5 and TO18 can sizes, are available from the Telecommunications Division of

Associated Electrical Industries, Woolwich. The pads are suitable for use at temperatures in the range −50° to +175°C and moulded-in bosses hold both pad and transistor clear of the printed board. This allows free circulation of air between pad and board. Other features of these components are the prevention of movement of, and possible damage to, transistor leads after assembly, a reduction in the risk of damage to the transistor during soldering, and the fact that transistors are more easily mounted in a consistent pattern.

5WW 332 for further details

Precision Resistors

A STABILITY of better than ±0.003%, measured against standards of ±0.001% tolerance, is claimed for resistors in the "J" series introduced recently by Alma Components of Diss, Norfolk. Loose-winding techniques are used in the construction of these components. The resistance wire is wound on an epoxy-resin former and sealed under "dry" conditions in an epoxy-resin tube. Seven types are available, ranging from $\frac{1}{8}$W up to 2W with values from 300kΩ to 3MΩ. Matched sets can be supplied to resistance tolerances of ±0.005% with temperature coefficient matching to ±$2\frac{1}{2}$ parts per million/°C. The cost of resistors from this "J" series is said to be only slightly higher than that of the normal precision resistors.

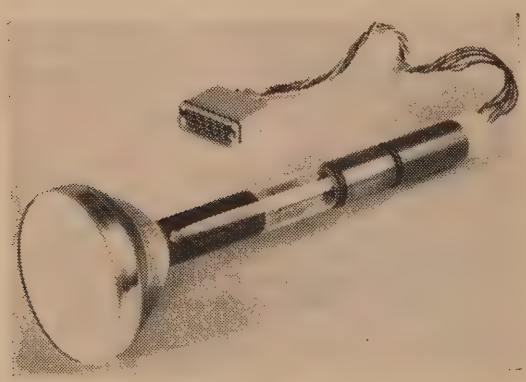
5WW 333 for further details

Electrostatic-focus Cathode Ray Tubes

ELECTROSTATIC focusing at near-cathode potential and low-power magnetic focusing techniques are combined in a new series of high-resolution cathode ray tubes developed by Ferranti of Hollinwood, Lancs. Tubes of this series which are available at present, Types 5E/12 and 3C/12, achieve a minimum spatial frequency response resolution of 150 cycles per centimetre. (Other types in development are capable of a spatial frequency response of 200 c/cm). Large electrostatic lenses are used, which, when operated at cathode potential act as the primary lens and only small degrees of spherical aberration and astigmatism are produced. Astigmatism-correction coils mounted on the neck of the tube reduces this latter effect. E.h.t. variations of up to 2% do not appreciably deteriorate focus. A small, low-power electromagnetic lens is employed as a secondary correction lens in the tube.

The maximum anode voltage is 20 kV while that of the electrostatic lens or second anode is 500V. The nominal grid voltage for usual cut-off is Va/300. The tubes have 6.3V heaters and the maximum resistance of the dynamic focus coils is 50Ω. Different phosphors are available and screen thicknesses are optimized for either 7kV or 15kV operation.

5WW 334 for further details



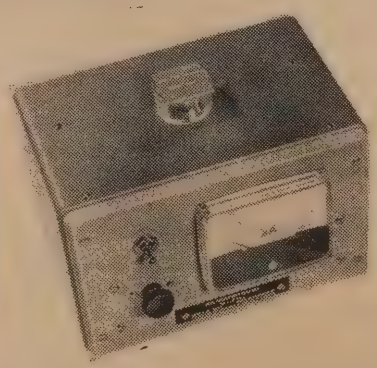
◀ *A 5-in version of the new Ferranti high-resolution cathode ray tubes.*

Colour Bar Generator

THE first in a range of British-manufactured R.C.A. colour television instruments, the colour bar generator Type WR-L64A is a portable unit providing colour bars, dots or cross-hatch pattern modulated on a r.f. carrier. A colour beam selector enables single colours to be displayed to facilitate colour-purity adjustments. The generator was designed for N.T.S.C. colour television receivers and is manufactured by R.C.A., Great Britain Ltd., Windmill Road, Sunbury-on-Thames, Middlesex. The picture carrier frequency is 55.25 Mc/s and that of the sound, 61.25 Mc/s; both are factory preset but are tunable. The picture carrier voltage is approximately 50 mV. The r.f. output impedance is 70Ω. The power requirement of the instrument is 40W (200-250V, 50 c/s). The generator costs £75.

5WW 335 for further details

▲ *Colour bar generator Type WR-L64A. Single colours may be selected to facilitate colour purity adjustments.*

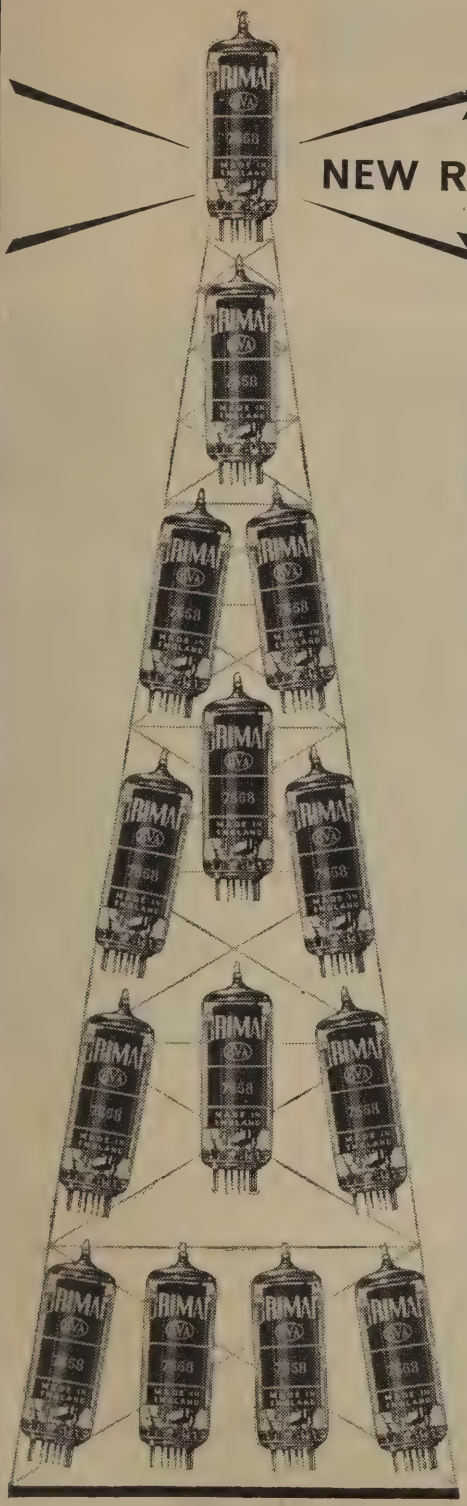


▲ *S.T.C. contactless, bulk resistivity test set, with a sample in the test position.*

Contactless Bulk Resistivity Measurement

AN interesting feature of a resistivity test set Type 74711, manufactured by S.T.C., is that samples of the material under test are not placed in electrical contact with the instrument which is designed to measure the damping effect of the sample on a lightly-loaded tuned circuit. This feature makes the test set particularly useful for production-line testing of thin slices of semiconductor material in the manufacture of transistors. If the resistivity of a semiconductor material is known, then the thickness of the sheet can also be measured. The instrument uses transistors and its dimensions are $8\frac{1}{4} \times 5\frac{1}{2} \times 6\frac{3}{8}$in; the weight is 5lb. The test coil projects $\frac{3}{4}$in above the top of the case.

5WW 336 for further details



NEW R.F. COMMUNICATIONS VALVE

BRIMAR

7558

improved POWER PENTODE operating up to 175 Mc/s

for use as an R.F. Amplifier · Oscillator · Frequency Multiplier or in A.F. Modulator and Amplifier applications

Heater Voltage Vh 6·3 V
Heater Current Ih 0·8 A

TYPICAL OPERATION		Push Pull A.F. Amplifier (Values for 2 Valves)	R.F. Power Amplifier Class C FM Telephony at 175 Mc/s	Frequency Doubler to 175 Mc/s	
Anode Voltage	Va	300	250	250	V
Screen Grid Voltage	V_{g2}	250	200	200	V
Control Grid Voltage	V_{g1}	—21	—40	—53	V
Grid Resistor	R_{g1}		27	53	kΩ
Peak R.F. Grid Voltage	$v_{g1(pk)}$		47	60	V
Peak A.F. Grid Voltage	$v_{g1(pk)}$-$v_{g1(pk)}$	40			V
D.C. Anode Current	I_a	40	60	50	mA
D.C. Screen Grid Current	I_{g2}	2·0	3·7	2·6	mA
D.C. Control Grid Current (Approx.)	I_{g1}		1·5	1·0	mA
Effective Load Resistance (Anode to Anode)	R_{a-a}	5·0			kΩ
Driving Power (Approx.)	P_{dr}		1·0	0·4	W
Useful Power Output	P_{out}	20·5	6·5	3·0	W
Total Harmonic Distortion	D_{tot}	5·0			%

Please ask for Data sheets

Thorn-AEI Radio Valves & Tubes Ltd.

HEAD OFFICE: 155 CHARING CROSS ROAD LONDON, W.C.2 Telephone: GERrard 9797

BRIMAR EXPORT DIVISION: THORN HOUSE UPPER ST. MARTIN'S LANE LONDON, W.C.2

5WW 097 FOR FURTHER DETAILS.

NAVAL RADIO TRANSMITTING SYSTEMS

■ Precise frequency setting and positive stability allows full advantage to be taken of SSB which provides the most reliable communications under difficult conditions of propagation or interference ■ Continuous frequency coverage from 240 Kc/s to 24 Mc/s ■ Covers all types of signalling ■ Broadband amplifier and synthesizer system provides simplest operation and almost eliminates tuning ■ Aerials can be sited for maximum radiating efficiency.

MARCONI NT 203/204 SYSTEMS

COMPLETE NAVAL RADIO AND RADAR SYSTEMS

THE MARCONI COMPANY LIMITED · CHELMSFORD ESSEX ENGLAND

5WW--098 **FOR FURTHER DETAILS.**

THE BODE FILLET

TO WHAT EXTENT SHOULD IT BE TAKEN INTO ACCOUNT IN AMPLIFIER DESIGN?

By THOMAS RODDAM

ONE of the major problems in life is the problem of communication. If a sufficiently general view is taken this need not be limited to the transmission of information but can be expressed as the problem of converting one ordered structure into another. This choice of definition enables the philosophy of the Second Law of Thermodynamics to be applied to political problems as well as to information theory. Maxwell's demon becomes the Minister for Colonial Reconstitution; a party in opposition tends to maximum disorder: these are two applications of the scientific method to everyday affairs.

This opening paragraph was produced by the interaction of two apparently unconnected matters. The first was a book review in which some unlucky author was taken to task for flippancy: the second was some material, which I propose to examine in detail, on the Bode ideal loop-gain characteristics in a recently published text. There can be no doubt that flippancy has no place in a serious and advanced text. One should "reject all amplification, digressions and swellings of style." If the aim is to convey new information to those who can understand it there is nothing like "the primitive purity and shortness" recommended by Thomas Sprat.

It is true that in a perfect communication channel we need no redundancy and we can use highly efficient coding systems properly adapted to the information to be transmitted. With some diffidence I suggest that the reader is not an ideal receiver. He has not stored, for immediate access, all the information which has been sent to him previously: the noise level is high, for as he reads this the children are watching "Cosh," the do-it-yourself television series for juvenile delinquents, his wife is reporting on the strange events in the supermarket, while thoughts of the gas bill and the odd rattle inside his motor car come creeping in. The writer of "texts of interpretation" is seeking a method of coding information which will carry it past these obstructions. Often, I believe, the main obstruction is that the reader cannot believe that he can understand what is being said. Of course he can, and in a couple of weeks he is explaining it all, at tedious length, to the author from whom he learnt it. Right now, however, he is on the verge of collapse. Flippancy is a great aid in making the reader relax, in making him realize that if the author, who is so obviously stupid, understood what he wrote it must be within the comprehension of any normal reader.

Many readers have been frightened off by the rather formal sections at the beginning of Bode's "Network Analysis and Feedback Design" (D. van Nostrand Company). If you are to tackle the more advanced problems of amplifier design, however, there is a vast amount of material here which you cannot afford to ignore and which is too extensive to absorb if it is watered down. Mr. Edwin has recently reminded us of the basics and essentials of the subject but, valuable as Basic English is, the student cannot stop there. The day will come when someone says "Agenbite of inwit" to him and two of these three words are not among the most common one-thousand words of the English language.

The idea of an ideal cut-off characteristic for single-loop amplifiers is a plausible one. Let us consider the simple form first. The initial assumption is that the loop gain should be constant over the whole working band. Outside this band the gain should fall as rapidly as possible so that the loop gain will reach unity quickly in order to reduce the frequency range over which the characteristic must be controlled. This aspect of the problem becomes more important as we use transistors, since the delay-line effect of the diffusion process gives us an excess phase shift at high frequencies. The lumped

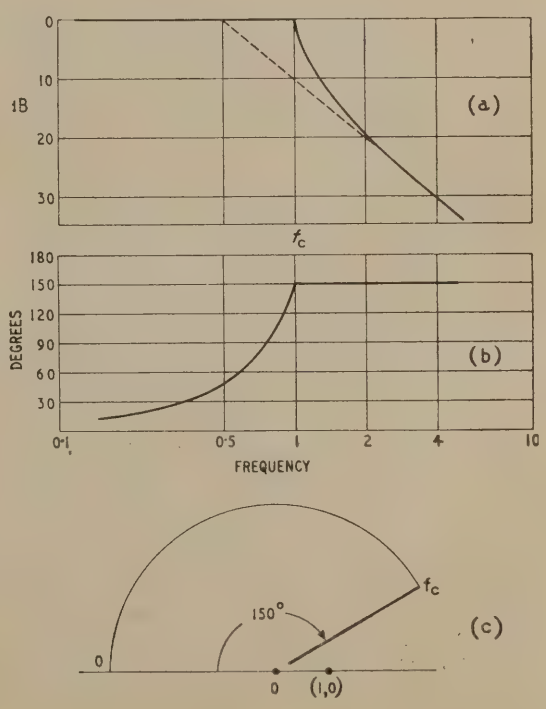


Fig. 1. Typical amplitude (a) and phase (b) characteristics, and (c) the corresponding Nyquist diagram. The area between the dotted and solid lines in (a) has been termed the "Bode fillet".

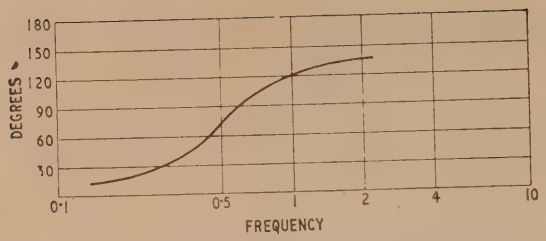


Fig. 2. Phase characteristic corresponding with a gain characteristic following the asymptote in Fig. 1 (a).

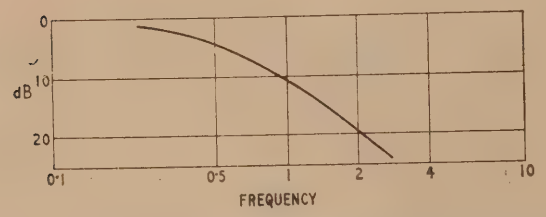


Fig. 3. Amplitude response in an amplifier with inter-electrode and stray capacitance.

elements of normal amplified circuits are almost invariably minimum-phase networks and so we can say that the amplifier phase-shift will be proportioned to the local average rate of cut-off.

The phase shift, for an unconditionally stable amplifier, must not exceed 180° until the loop gain has fallen below unity. In a practical design it is usual to call for a margin of some 30° or more. The Bode basic ideal cut-off assumes a constant 150° phase shift at all frequencies above the maximum working frequency. It is a straightforward problem to solve the equations connecting phase and amplitude with these conditions and to derive the amplitude and phase response shown as Fig. 1(a) and (b). The Nyquist diagram is the extremely simple form shown in Fig. 1(c).

The features of interest here are the asymptotic slope of the amplitude characteristic, 10dB/octave, and the relationship of this asymptote to the cut-off frequency. The slope is determined by the phase shift in the cut-off region and the relationship is a very simple one, most conveniently written as a statement that the slope of the asymptote in dB/octave is equal to (phase shift)°/15. This, of course, only applies when the effects of discontinuities have been excluded. The asymptote cuts the low-frequency gain line at $f_c/2$, one-half the cut-off frequency. There is thus a region in which the gain exceeds the asymptotic gain filling the gap between $f_c/2$ and f_c. If it were not for this the phase characteristic would take the form shown in Fig. 2 and, of course, the amount of feedback available at f_c would be 10dB. It is this area above the asymptote which I have recently seen described as Bode's fillet.

In spite of the theoretical charm of this ideal characteristic, I have never been too happy about its utility. There is no doubt that it is seminal, but the ideas are dangerous in the hands of the unwary. Suppose that we assume 20dB of feedback. The $\mu\beta$ effect at low frequencies will be about −0.8dB but at cut-off frequency the $\mu\beta$ effect is +0.8dB and it rises to a maximum of +6dB when the $\mu\beta$ gain is +1dB. The overall response will thus show a peak of about 7dB at $2f_c$.

This peak represents some 6dB of positive feedback. Any distortion produced by the amplifier at this frequency will be doubled. Any signal entering the amplifier at this frequency will not emerge at an amplitude reduced by the effect of the negative feedback but at an amplitude increased by the positive feedback. I have pointed out before that it is not enough to say that musical instruments do not produce much high-frequency energy and that, therefore, if there is no cross-over distortion there can be no distortion at all. The low-frequency sounds can be considered to pre-empt most of the amplitude range, holding the high frequencies in the overload region for much of the time. Pimonow's results (*W.W.*, Oct., 1962, p. 493) lead one to wonder how a boy who can detect cut-off in the region of 45 kc/s will react to harmonics in this region. Fortunately most of our loudspeakers will dispose of any energy up here without finding it necessary to radiate it as sound.

The reader who has not studied Bode's own writing may be surprised at the form given in Fig. 1 for the ideal gain characteristic. In some references a jump is made directly to the more sophisticated form given later by Bode which incorporates a step of flat gain near the critical point. The treatment of this is extremely interesting, progressing through the system having a phase shift of 180° up to the frequency at which the step takes charge and on to the safer solution providing both gain and phase margins before the final high-slope asymptote is reached. The effect of making the step a sloping one is considered, but only in terms of stability. Since we can never produce a practical circuit which follows the ideal characteristics exactly it is very valuable to know how deviations from the theoretical solution will affect the stability.

My chief concern here is with the Bode fillet. It may be that you feel like a tax inspector, that there is a lot of expense-account lunch to very little business, but one half-pennyworth of bread to this intolerable deal of sack. I can only hope that you go on to add "we'll read it at more advantage." (Henry IV, Pt. 1, Act II, Scene IV.)

A practical amplifier circuit which contains no transformers will usually have a response determined

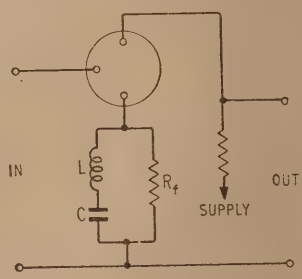


Fig. 4. Circuit to provide the Bode fillet when it is missing.

by a number of RC circuits and the capacitance will be the inter-electrode and stray capacitances. The sort of response we might find is shown in Fig. 3. This has not been worked out in any details but is intended to serve as a typical shape for a system with, for example, two or three staggered cut-off frequencies. Here there is no trace of the Bode

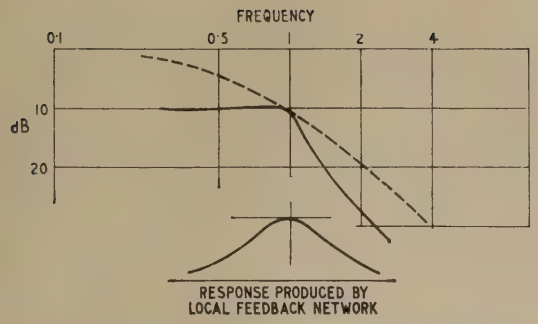


Fig. 5. Response of Fig. 3 modified by a resonance.

fillet, and in fact this particular curve is stretched to be below the 10dB/octave asymptote. It has been suggested, and it was this suggestion which prompted me to write this article, that we should add the network shown in Fig. 4 as L, C, R_f to provide the Bode fillet. The curious symbol for the amplifying device represents either a common-cathode valve or a common-emitter transistor of either polarity. I do not believe there is a standard symbol for this, possibly because the symbol seekers are so committed to keeping negative and north apart on their page (no mnemonic needed) that they cannot draw a circuit in this general form.

This network will provide local negative feedback at all frequencies except in the neighbourhood of the resonant frequency of the LC circuit. The rough shape of this is shown in the lower curve of Fig. 5 and the effect of combining it with the smooth roll-off of Fig. 3 has been sketched in above. The resulting form is a response held well up to the corner frequency and then dropping sharply before flattening away to run parallel to the original characteristic. This is, indeed, just what the doctor (H. W. Bode, Ph.D.) ordered. Well, my doctor has ordered a prescription containing oil of cajuput, but he does not expect me to swallow it: apply by massage it says on the box. I refuse to swallow this negative feedback device either.

In a desire to achieve an ideal-looking response a large amount of local negative feedback has been applied over most of the working band We know this is a very extravagant way of using negative feedback and that we get a much better overall performance by applying the feedback right round the loop. Even formally it is not correct, since Bode has limited his study to single-loop systems and this local feedback converts the amplifier into a multiple-loop circuit. In producing the Bode fillet the local feedback has dropped the gain of the amplifier substantially, a figure of 10dB is typical, in the low-frequency region. There is little benefit in return, for the stability conditions are fixed by the behaviour well beyond the influence of this circuit. The loop feedback may, in theory, remain the same, but in that event we must find another 10dB of gain from somewhere. In my experience not only are we already rather short of gain but we could find better uses for any spare gain, if we had it.

Let us see why the Bode fillet crept in at all. The real object of the exercise was to concentrate the available gain-bandwidth into the region where the gain would be useful. The more gradual the cut-off slope, the more gain there is at frequencies where, we have decided, there is no signal. Furthermore, the more gain there is at frequencies at which the performance is getting less and less under no control and more under the control of stray effects. There are, I know, gentlemen who devote a good deal of energy to snatching pay-rolls in order to make up for their losses at the races. Using local feedback in the way just described seems quite illogical. The correct approach, surely, is to design the Bode fillet into the response. For this we need what used to be called the Wheeler network (*Proc. I.R.E.* July, 1939).

The basis of all the theory is the fact that an interstage coupling, and this includes the cases where one or other "stage" is either generator or load, cannot avoid the presence of the capacitance C shown in Fig. 6. I do not propose to recapitulate the theoretical difficulties which we encounter in the absence of this capacitance, nor do I propose to show that if you cut out one parasitic capacitance at one place by a circuit trick it will return to plague you elsewhere. Some aspects of this problem were discussed in *Electronic Technology*, March, 1960,

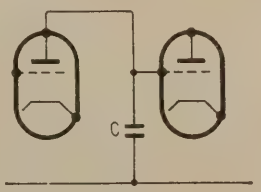


Fig. 6. The unavoidable capacitance.

pp. 127-9. However, once this capacitance is introduced, as physically we know it must be, it can be shown that the average gain over the whole frequency spectrum cannot be greater than that given when we have only the capacitance there. An interstage network can reduce the average gain, it can redistribute the gain within the spectrum, but it cannot increase it.

Performance limit theorems of this kind are of very great practical importance because they tell us just how near to the ideal we have reached and save us wasting time in what is really a quest for perpetual motion. This, indeed, is not a far-fetched simile, because if you integrate Johnson noise produced by a resistance without introducing the stray capacitance you will find you have a power source,

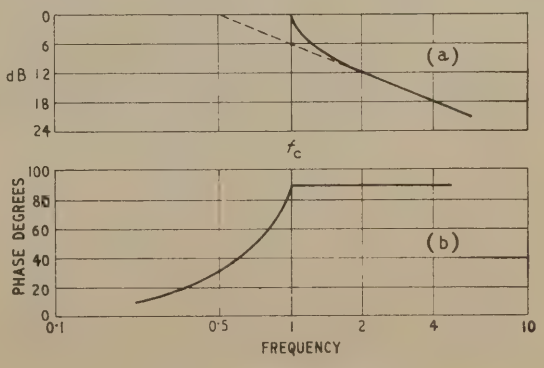


Fig. 7. Characteristics using the Wheeler networks and limiting phase shift to 90°.

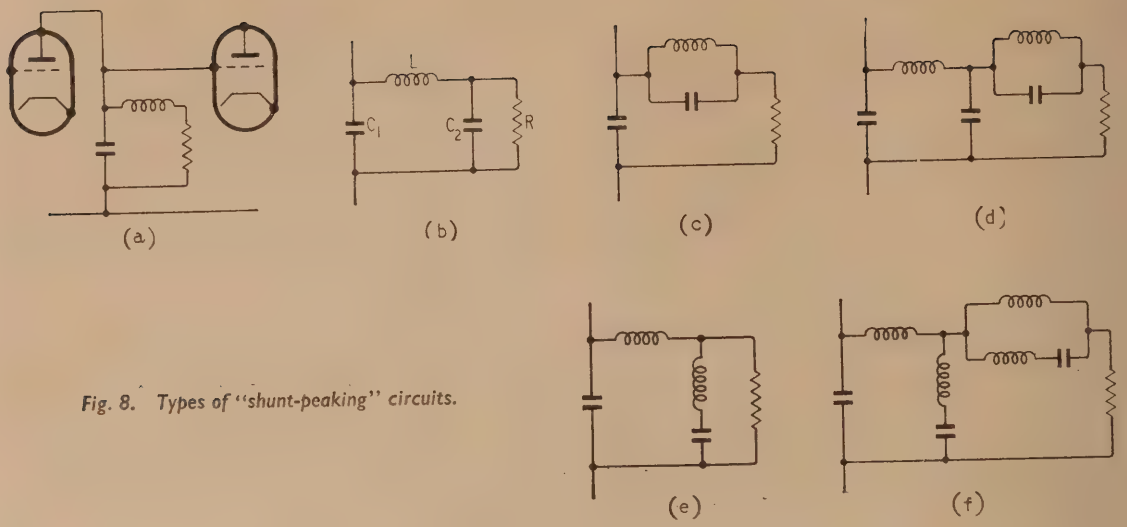


Fig. 8. Types of "shunt-peaking" circuits.

as van der Pol has shown. The theory also leads to the conclusion that any conductance at infinite frequency in parallel with the capacitance reduces the average gain.

The Wheeler networks are circuits which have zero conductances at infinite frequency and which perform the task of concentrating the gain as far as possible into the working band. The formal mathematics of the situation bears a close resemblance to the formal mathematics of the ideal loop characteristic. The limiting phase shift of the stage is 90°, since at a sufficiently high frequency one capacitance must take charge. To get maximum gain the 90° phase shift should extend over the whole spectrum outside the working band, in which the gain should be constant. The resulting amplitude and phase characteristics are shown in Fig. 7. The amplitude response is asymptotic to the 6dB/octave slope fixed by the capacitance, but instead of there being a smooth curve lying below this, as we should have with a resistance as the interstage network, the ideal interstage network gives us the 6dB lift at the edge of the working band and shows the characteristic shape of the Bode fillet.

It is very tempting to suspect that the use of local feedback to produce the wanted shape should lead to the same end result and that is only a difference in circuit configuration which conceals this fact. This is not so and I think that its falsity can be demonstrated quite simply. When a resistance is used alone as the coupling element some energy must be lost in this resistance and the useful average gain is thereby diminished. The negative feedback can only redistribute this reduced average gain. The discussion should, indeed, be a little more subtle, dealing with the average gain outside the working band, but then we approach the point when we might just as well carry out a formal analysis.

The Bode fillet is something very real in this context: it is useful gain which has been rescued from the part of the frequency spectrum beyond the working band. How are we to get the required response from a practical circuit? The answer is that we must make use of the fact that the required total band impedance which gives us a gain characteristic g_mZ shown in Fig. 7 must be the input impedance of a low-pass filter. One-half of the capacitance is then absorbed in the filter and this factor of one-half accounts for the 6dB advantage which you can see we have at the cut-off frequency in Fig. 7(a).

The simplest practical structure used in this way is the so-called shunt-peaking circuit shown as Fig. 8(a), but more complex networks based on the use of full sections and on the use of m-derived and double m-derived sections to provide better matching are given by Bode with their response curves and are shown in Fig. 8: the double m-derived system in Fig. 8(f) matches the required response so closely that Bode does not draw the response but merely inserts some calculated points.

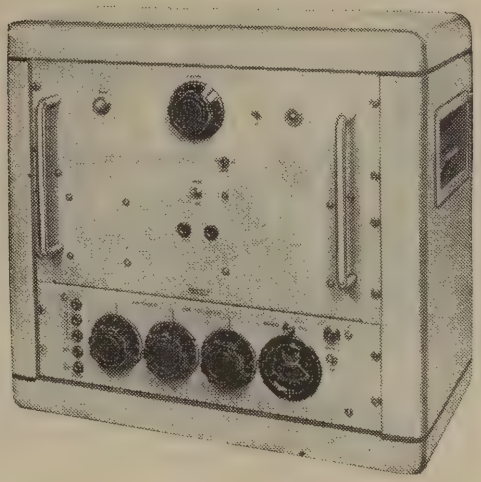
For general purposes the netwok of Fig. 8(b) is probably the most important. It uses only the same number of extra components as the circuit of Fig. 4 and it has a response which is about 3dB down at the band edge. By changing definitions a little we might say that at a cost of about 1dB in gain inside the working band we can provide a flat response which is defined by an ideal cut-off frequency of 1.1 times the upper working frequency. In practice, however, we should not use a succession of flat response circuits. When the inductance in Fig. 8(a), for example, is made to have a higher value than the flat-response value we find that the response will peak upwards before cutting off in very much the same way as we can get a mismatch at the edge of a filter response. The rising slope of such a peaked response forms a convenient way of compensating for the gentle droop of a pure RC network. Very often we find that this compensation can be made by using the leakage inductance of the output transformer so that we need add no physical inductor at all.

Whatever means are adopted to produce the Bode type of response in an amplifier we must accept the fact that we are making trouble for ourselves. The sharp cut-off associated with the flat gain inside the working band gives us a rapid approach to 90° phase

(*Continued on page 105*)

Vortexion
quality equipment

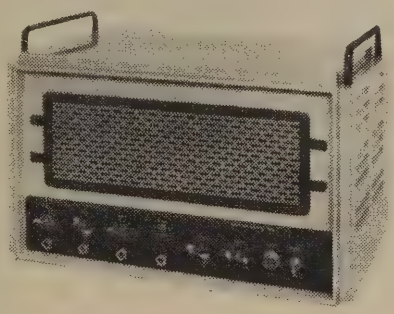
120/200 WATT AMPLIFIER



Will deliver 120 watts continuous signal and over 200 watts peak Audio. It is completely stable with any type of load and may be used to drive motors or other devices to over 120 watts at frequencies from 20,000 down to 30 cps in standard form or other frequencies to order. The distortion is less than 0.2% and the noise level —95 dB. A floating series parallel output is provided for 100–120 V. or 200–250 V. and this cool running amplifier occupies 12¼ inches of standard rack space by 11 inches deep. Weight 60lb.

30/50 WATT AMPLIFIER

Gives 30 watts continuous signal and 50 watts peak Audio. With voice coil feedback distortion is under 0.1% and when arranged for tertiary feedback and 100 volt line it is under 0.15%. The hum and noise is better than —85 dB referred to 30 watts.



It is available in our standard steel case with Baxendall tone controls and up to 4 mixed inputs, which may be balanced line 30 ohm microphone or equalised P.U.s to choice.

Price with 4 mixed inputs **£65.0.0d.**

ELECTRONIC MIXER/AMPLIFIER

This high fidelity 10/15 watt Ultra Linear Amplifier has a built-in mixer and Baxandall tone controls. The standard model has 4 inputs, two for balanced 30 ohm microphones, one for pick-up C.C.I.R. compensated and one for tape or radio input. Alternative or additional inputs are available to special order. A feed direct out from the mixer is standard and output impedance of 4–8–16 ohms or 100 volt line are to choice. All inputs and outputs are at the rear and it has been designed for cool continuous operation either on 19 x 7in. rack panel form or in standard ventilated steel case.

Size 18 x 7½ x 9½in. deep.

Price of standard model **£49.**

12-WAY ELECTRONIC MIXER

The 12-way electronic mixer has facilities for mixing 12 balanced line microphones. Each of the 12 lines has its own potted mumetal shielded microphone transformer and input valve, each control is hermetically sealed. Muting switches are normally fitted on each channel and the unit is fed from its own mumetal shielded mains transformer and metal rectifier.

Also 3-way mixers and Peak Programme Meters.

Price **£60.0.0d.**

4-way Mixers from **£40.8.6d.**

2 x 5-way stereo mixers with outputs for echo chambers, etc., available.

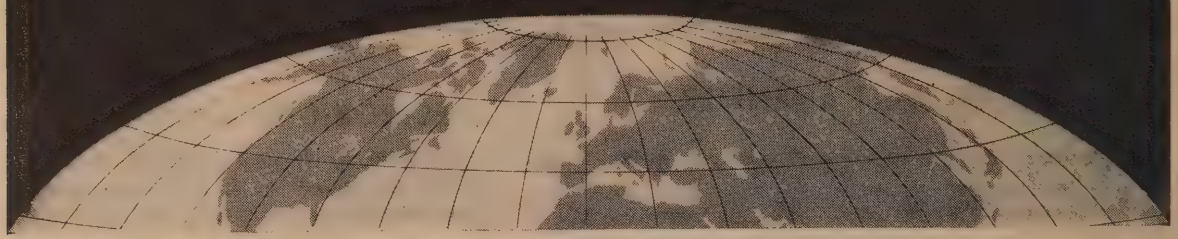
Price of standard model **£98.0.0d.**

Full details and prices of the above on request

VORTEXION LIMITED, 257-263 The Broadway, Wimbledon, London, S.W.19

Telephones: LIBerty 2814 and 6242-3 **Telegrams: "Vortexion, Wimble, London**

THERE'S A WORLD OF EXPERIENCE IN EVERYTHING MARCONI'S DO



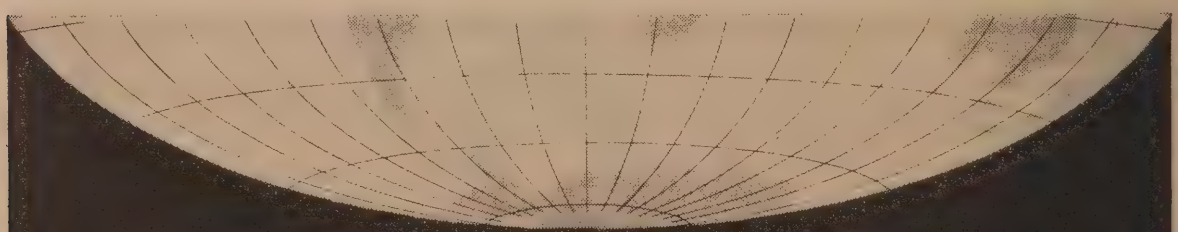
The Post and Telegraph Authorities of more than 80 countries rely on Marconi telecommunications equipment

SURVEYS ★ Marconi's telecommunications survey teams are at work in many parts of the world. Marconi's is the only company maintaining a permanent research group working entirely on wave propagation.

INSTALLATION ★ Marconi's installation teams undertake complete responsibility for system installation, including erection of buildings and civil engineering works as well as the installation of the telecommunications equipment and auxiliary plant.

PLANNING ★ Marconi's vast experience is reflected in the quality of its system planning organisation which is constantly employed on planning major telecommunications systems for many parts of the world.

MAINTENANCE ★ Marconi's provide a complete system maintenance service and undertake the training of operating and maintenance staff, either locally or in England. Marconi's also establish and manage local training schools for Post and Telegraph Authorities.



MARCONI *TELECOMMUNICATIONS SYSTEMS*

COMMUNICATIONS DIVISION, THE MARCONI COMPANY LIMITED, CHELMSFORD, ESSEX, ENGLAND

5WW—100 FOR FURTHER DETAILS.

shift in each stage. Even a two-stage amplifier will need a very distinct step in the response in the region where the Nyquist plot is near the danger point (1, 0) and the loop round this point must be large enough to allow for all the gain tolerances. As far as I can make a generalization I would say that sophistication in stage design breeds sophistication in feedback network design. Readers who have recently bought Rolls-Royces may have noted that they feel an urge to be better dressed. When we turn to three-stage amplifiers, which are probably the most common of our feedback problems, we are usually too preoccupied with the problem of limiting the initial slope, and thus the phase-shift of the cut-off characteristic, to be concerned with the few decibels at the corner. I am inclined to wonder whether we have made sufficient use here of inductive compensation. In Fig. 9 we have the response of the network of Fig. 8(b) when $C_2=2C_1$ and $L/C=R^2/4$. This gives us a step some 9dB below full gain and the correspondingly slow run of the phase angle. Normally we should produce a step of this kind by adding an RC network, but the whole response would then be moved in under the basic RC roll-off. The step we have here is out beyond the frequency fixed by the low frequency load and the circuit capacitance. Thus although the roll-off appears to be unpleasantly gentle it does not start at nearly such a low frequency: for the factor of 8-9dB at which the step occurs we must allow a factor of 3 in the frequency scale, so that this response is 1dB down where the conventional CR step would be 3dB down.

A rough calculation, based on a capacitance of 50pF and a resistance of 20,000 ohms leads to an inductance value of 5mH. There are some difficulties, since I suspect that we shall need to allow for the effect of the self-capacitance on the inductor. This art, however, appears to be a technique deserving rather more attention than it has received. The

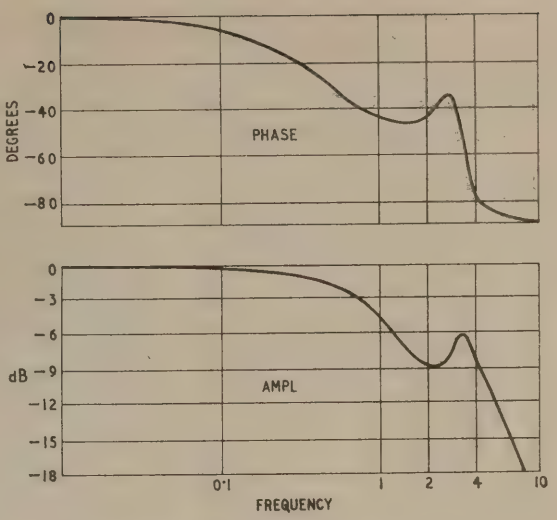
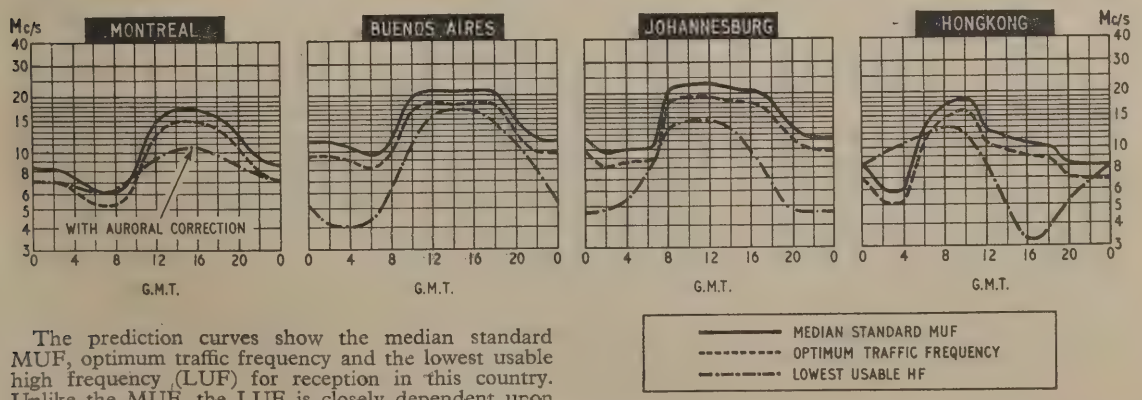


Fig. 9. Response of the network of Fig. 8(b).

curves shown in Fig. 9 are typical of a large set given by Bode (pp. 445-450) which can be used for marrying-up shapes to get what we need in a particular design.

There is, I think, a general moral to be drawn. Simple solutions to complex problems are not necessarily good. A feedback amplifier design can proceed very well without using the idea of the Bode fillet and the problem becomes relatively simple, since we can adopt the rather rough and inefficient RC network solutions. If we try to make an efficient amplifier design we must go right to the heart of the matter, it is the designer's choice, fish or cut bait.

H. F. PREDICTIONS — FEBRUARY



The prediction curves show the median standard MUF, optimum traffic frequency and the lowest usable high frequency (LUF) for reception in this country. Unlike the MUF, the LUF is closely dependent upon such factors as transmitter power, aerials, local noise level and the type of modulation; it should generally be regarded with more diffidence than the MUF. The LUF curves shown are those drawn by Cable and Wireless, Ltd., for commercial telegraphy and they serve to give some idea of the period of the day for which communication can be expected.

FEBRUARY MEETINGS

Tickets are required for some meetings: readers are advised, therefore, to communicate with the secretary of the society concerned

LONDON

5th. I.E.E.—"Recent developments in radar modulation systems" by R. Benjamin at 5.30 at Savoy Place, W.C.2.

5th. Brit.I.R.E.—"The Omnitrac II computer" by J. A. Ashton at 6.0 at the London School of Hygiene, Keppeli Street, W.C.1.

5th. Brit. Kinematograph Soc.—"Synchronous tape sound systems" a survey by five speakers of some ¼in tape systems used for television at 7.30 at the Central Office of Information, Hercules Road, Westminster Bridge Road, S.E.1.

7th. Television Society.—"Television service planning for overseas" by D. Law, A. A. McKerrell & T. D. Barritt at 7.0 at the Conference Hall, I.T.A., 70 Brompton Road, S.W.3.

12th. I.E.E.—"Newton and Heaviside in control" by G. G. Gouriet at 5.30 at Savoy Place, W.C.2.

12th. Brit.I.R.E.—"Correlation techniques in studio testing" by A. N. Burd at 6.0 at the London School of Hygiene, Keppell Street, W.C.1.

13th. Radar & Electronics Assoc.—"Radar meteorology" by R. F. Jones at 7.0 at the Royal Society of Arts, John Adam Street, W.1.

17th. I.E.E.—Discussion on "Factors affecting the quality of pictures read off camera tubes and storage tubes" at 5.30 at Savoy Place, W.C.2.

18th. I.E.E.—Discussion on "Teaching active network theory" at 5.30 at Savoy Place, W.C.2.

20th. Institution of Electronics.—"Developments in electronic telephone exchanges" by K. A. T. Knox at 7.0 at the London School of Hygiene, Keppell Street, W.C.1.

21st. Institute of Navigation.—"Lasers" by P. G. R. King at 5.30 at the Royal Institution of Naval Architects, 10 Upper Belgrave Street, S.W.1.

21st. Television Society.—"The testing of mass-produced television receivers" by D. W. Maguire at 7.0 at the I.T.A., 70 Brompton Road, S.W.3.

21st. B.S.R.A.—"The subjective assessment of noises" by D. W. Robinson at 7.15 at the Royal Society of Arts, John Adam Street, W.C.2.

26th. Brit.I.R.E.—"High definition radar" by J. M. G. Seppen at 6.0 at the London School of Hygiene, Keppell Street, W.C.1.

ABERDEEN

26th. I.E.E.—"From graduate to professional engineer" by J. E. C. McCandlish at 7.30 at Robert Gordon's Technical College.

BASINGSTOKE

6th. Brit.I.R.E.—"Solid-state switching" by A. C. Savage at 7.30 at the Technical College.

BIRMINGHAM

10th. I.E.E.—"Harmonics and transients in relation to static converters" by R. A. Hammond at 6.0 at the College of Advanced Technology.

24th. I.E.E.—"Post Office colour television network" by J. B. Sewter and P. J. Edwards at 6.0 at the College of Advanced Technology.

BOLTON

6th. Brit.I.R.E.—"Some aspects of the use of radio telemetry in small vehicle research and development" by M. A. Millward at 7.0 at the Technical College.

BOURNEMOUTH

19th. Brit.I.R.E.—"Electronic techniques in the study of the sea" by M. J. Tucker at 7.0 at the Municipal College of Technology and Commerce.

BRISTOL

11th. Brit.I.R.E. & R. Aero. Soc.—"Redundancy techniques for reliability in aviation electronics" by R. K. Barltrop at 6.30 at the University Engineering Lecture Rooms.

19th. Society of Instrument Technology.—"Introduction to digital instrumentation" by Dr. M. J. White at 7.30 at the University, The Royal Fort.

CAMBRIDGE

18th. I.E.E.—"The colour performance of the Secam system" by G. B. Townsend at 8.0 at the Engineering Laboratories, Trumpington Street.

CARDIFF

5th. Brit.I.R.E.—"Semiconductor integrated circuits" by M. S. Alderson at 6.30 at the Welsh College of Advanced Technology.

CHELTENHAM

3rd. Society of Instrument Technology.—"Industrial applications of digital read-out systems" by G. Rigby at 7.30 at the Belle Vue Hotel.

28th. Brit.I.R.E.—"A practical method of implementing a step towards full automation" by F. S. Ellis at 7.0 at N. Gloucestershire Technical College.

CHRISTCHURCH

12th. I.E.E.—"Present state of colour television" by S. N. Watson at 6.30 at the Kings Arms Hotel.

DUBLIN

20th. I.E.E.—"Telecine systems" by T. J. Murphy at 6.0 at the Physics Laboratory, Trinity College.

DUNDEE

27th. I.E.E.—"From graduate to professional engineer" by J. E. C. McCandlish at 7.0 at the Electrical Engineering Department, Queen's College.

EDINBURGH

5th. Brit.I.R.E.—"Numerical control of machine tools" by D. F. Walker at 7.0 at the Department of Natural Philosophy, The University, Drummond Street.

11th. I.E.E.—"Radio astronomy techniques," by H. Gent at 7.0 at the Carlton Hotel.

FARNBOROUGH

25th. I.E.E.—"Recent developments in components for computers" by W. Renwick at 6.15 at the Technical College, Boundary Road.

27th. Brit.I.R.E.—"An introduction to the theory and application of piezoelectric transducers" by R. F. J. Orwell at 7.0 at the Technical College.

GLASGOW

4th. I.E.E.—Discussion on "The Robbin's report" opened by Sir David Anderson at 7.30 at the University.

6th. Brit.I.R.E.—"Numerical control of machine tools" by D. F. Walker at 7.0 at the Institution of Engineers and Shipbuilders, 39, Elmbank Crescent.

10th. I.E.E.—"Radio astronomy techniques" by H. Gent at 6.0 at the Royal College of Science & Technology.

LEEDS

4th. I.E.E.—"Stereophonic broadcasting systems" by Dr. G. J. Phillips at 6.30 at the Electrical Engineering Department, the University.

25th. I.E.E.—"Optical masers" by I. L. Davies at 6.30 at the Department of Electrical Engineering, the University.

"WIRELESS WORLD" PUBLICATIONS

	Net Price	By Post
COLOUR TELEVISION: N.T.S.C. System, Principles and Practice. P. S. Carnt, B.Sc.(Eng.), A.C.G.I., A.M.I.E.E., and G. B. Townsend, B.Sc., F.Inst.P., M.I.E.E., A.K.C.	85/-	87/3
RADIO AND ELECTRONIC LABORATORY HANDBOOK M. G. Scroggie, B.Sc., M.I.E.E. 7th Edition	55/-	57/3
PRINCIPLES OF TRANSISTOR CIRCUITS S. W. Amos, B.Sc.(Hons.), A.M.I.E.E. 2nd Edition	21/-	22/-
TELEVISION ENGINEERING Vol 1 2nd Edition S. W. Amos, B.Sc. (Hons.), A.M.I.E.E., and D. C. Birkinshaw, M,B.E., M.A., M.I.E.E., in collaboration with J. L. Bliss, A.M.I.E.E.	45/-	46/2
PRINCIPLES OF FEEDBACK DESIGN G. Edwin and Thomas Roddam	45/-	46/2
WIRELESS SERVICING MANUAL 10th Edition W. T. Cocking	25/-	26/-
TRANSISTOR INVERTERS AND CONVERTERS Thomas Roddam	42/-	43/-
ESSAYS IN ELECTRONICS M. G. Scroggie, B.Sc., M.I.E.E.	42/-	43/1
MICROPHONES A. E. Robertson, B.Sc.(Eng.), A.M.I.E.E. 2nd Edition	75/-	76/2

A complete list of books is available on application.

Obtainable from all leading booksellers or from

ILIFFE BOOKS LTD., Dorset House, Stamford Street, London, S.E.1

LEICESTER
11th. Television Society.—"Some factors affecting the choice of a colour television system" by R. N. Jackson at 7.15 at the New Vaughan College, St. Nicholas Street.

LIVERPOOL
17th. I.E.E.—"Parametric amplifiers" by Dr. F. J. Hyde at 6.30 at the Royal Institution, Colquitt Street.
19th. Brit.I.R.E.—"Automatic marshalling yards" by J. M. Howe at 7.30 at the Walker Art Gallery.

MANCHESTER
11th. I.E.E.—"Mathematics as an educational discipline for the engineer" by P. L. Taylor at 6.15 at Reynolds Hall, College of Science and Technology.

MIDDLESBROUGH
5th. I.E.E.—"Lasers: principles and applications" by Dr. R. P. Howson at 6.30 at Cleveland Scientific and Technical Institute.

NEWCASTLE-UPON-TYNE
12th. Brit.I.R.E.—"The role of the engineer in medicine" by W. J. Perkins at 6.0 at the Institute of Mining and Mechanical Engineers, Westgate Road.
20th. Society of Instrument Technology.—"Telecommunications" by R. Taylor at 7.0 at the Conference Room, Roadway House, Oxford Street.

NEWPORT, I.o.W.
7th. I.E.E.—"Communication satellites" by Dr. K. Milne at 6.30 at the Technical College, Hunnyhill.

PLYMOUTH
20th. I.E.E.—"Satellite communications" by D. Wray at 3.0 at the Continental Hotel, Millbay Road.

PORTSMOUTH
12th. I.E.E.—"A survey of magnetic tape and ferrite core storage systems" by P. P. A. Calvert and J. H. Streeter at 6.30 at the College of Technology.

RUGBY
25th. I.E.E.—"Global communications" by R. J. Halsey at 6.30 at the Rugby College of Engineering Technology.

SHEFFIELD
20th. I.E.E.—"The ultra-sound image camera" by Dr. C. N. Smyth at 6.30 at the University.

SWANSEA
20th. I.E.E.—"Pulse techniques in line communication" by R. O. Carter at 6.0 at College House, University College, Singleton Park.

TORQUAY
5th. Brit.I.R.E. & I.E.E.—"The principles and technology of lasers" by Dr. R. C. Smith at 6.30 at the South Devon Technical College.

WEYMOUTH
14th. I.E.E.—"The field-effect transistor and its applications" by C. S. den-Brinker at 6.30 at the South Dorset Technical College.

WOLVERHAMPTON
12th. Brit.I.R.E.—"Mathematical training for engineers" by N. Bright and F. J. Hawley at 7.15 at the College of Technology.

EFFICIENT CONTROL

"THE CHOICE OF CRITICS" BULGIN

FOR BUSY EXECUTIVES

6 LAMP UNIT

6 LAMP UNIT

9 LAMP UNIT

6 LAMP UNIT

In simplest form, the Bulgin Desk-Switch plus Bulgin Door-Annunciator, gives Callers an "ENGAGED" or "WAIT" or "ENTER," brilliant illuminated signal. Combined with a normal bell-push and bell or buzzer system, or upon knocking, the above signals may be given as an answer to the caller. We make the special Door-Annunciator, and the special Desk-Switch, sold direct or through your local retailer. The latter will also supply (*and may install*) **standard wire, bell-equipment, etc., and suitable-Voltage bulbs for the Door-Annunciator. Installation is easy and quick. Wiring can be unobtrusive. Reliability is assured.**

The Door Annunciator Unit, top left, can also be moulded in high gloss Black or Walnut bakelite. The standard messages are **ENTER, ENGAGED, WAIT** coloured Green, Red and Amber respectively but other messages can be supplied at slight extra cost. The unit is easily mounted on the wall and takes miniature L.E.S. lamps.

The Desk-Switch is shown below, Moulded in high gloss Black or Walnut bakelite (*state which is required when ordering*), with the three switch dollies coded **ENTER, ENGAGED** and **WAIT**, and coloured Green, Red and Amber respectively. Any one of the three messages can be lit up continuously, or just to answer each caller who rings or knocks. Very simple wiring; anyone can arrange installation with very little effort.

Standard finish for the Desk Switch is all black, specifications as above to order only.

In addition to the combined Desk Switch and Door Indicator, illustrated and described above we can supply one-off to many thousands-off of the legend indicator alone—List No. D.830 or D.831 **engraved in several styles and in many languages to customer's order. Four typical examples of other legending are shown immediately above, details of which are more fully illustrated in our technical** leaflet 1505/C, **in addition to which we manufacture a further extensive range of legend indicators listed in our** leaflet 1512/C.

A. F. BULGIN & CO. LTD., BYE PASS RD., BARKING, ESSEX
TELEPHONE: RIPpleway 5588 (12 lines)

UNBIASED

By "FREE GRID"

"Hi-Res"

I WAS very interested to read the Editor's *ex-cathedra* remarks in the January issue on what, in his very first sentence, he terms "high-quality sound reproduction." We all know what he means, and yet the question arises at once whether it is etymologically possible for reproduction to be of high or low quality, or whether it is possible to have "hi," "lo" or any other sort of "fi."

It is clear, I think, that things described by the words "reproduction" and "fidelity," like the word "unique," either are or are not. They can have no qualifying adjectives of degree and so phrases like the all-too-common one "rather unique" are meaningless. However, the O.E.D. does allow "reproduction" to be used loosely in certain cases such as in connection with birth. Our children are not really reproductions of ourselves, and perhaps both the Editor's family and my own may find in this a cause of rejoicing as neither of us resembles Adonis.

We are all equally guilty in the misuse of certain words, but the Editor, by virtue of his position, does speak, like a bishop or a king, from the height of his *cathedra*, and that is why his words carry so much more weight than those of us lesser folk, and if he puts his foot in it he makes a much louder squelching noise when pulling it out.

The snag is I just cannot imagine what other phrase the Editor could have used to convey the meaning he intended. There is really no such thing as "reproduction" in the sense that the noise which comes out of our loudspeaker is exactly the same as that which went into the microphone.

I can only suggest rather faintheartedly the phrase "high degree of resemblance" to take the place of "high-quality reproduction." We could abbreviate it to "hi-res." I merely put it forward as a suggestion for you learned ones to get your teeth into.

Wireless for the Deaf

PROBABLY a great number of you listened to the annual appeal for the Wireless-for-the-Blind Fund which was made so effectively by Richard Dimbleby in the B.B.C.'s Home Service on Christmas Day.

We were informed, among other things, that a special set for a totally blind person costs only £10 as there is no purchase tax charged on it. As I listened I could not help wishing that some similar sort of thing could be done for those who have the misfortune to be deaf, or at any rate very hard of hearing.

Naturally I shall be told what I know already, namely that there are special attachments for coupling the earpiece or earpieces of a hard-of-hearing person direct to a suitable part of the circuit of a receiver. Particulars of these are readily obtainable from the Royal National Institute for the Deaf, 105, Gower Street, London, W.C.1.

My point is, however, that to the best of my belief there is no special receiver, free of purchase tax, which is available to those who are hard of hearing, corresponding to the one obtainable by the blind. There is certainly no annual appeal for wireless for the deaf.

Of course, I may be quite wrong. If so please don't hesitate to tell me. I am pachycephalous and pachydermatous—as well as being a married man—so hard words have little, if any, effect on me.

I have no particular axe to grind as my eyesight is only 2 or 3 dioptres down (or should I say up?) and my hearing only a few decibels down in the upper register, but I like to help people less fortunate than myself, more especially in the matter of hearing.

Philological Philistinism

IN the December issue I mentioned the lamentable errors made by a lady writer in an Essex newspaper giving biographical details of the famous scientist of palæo-Elizabethan days whom she and I both referred to as Dr. William Gilbert of Colchester. Mr. E. A. Payne, of Little Baddow, Essex, has written to the Editor, more in sorrow than in anger, to point out that the proper spelling of his name, as shown on his tombstone is Gilberd, the name by which he is always known by Colcestrians.

I am, however, not quite so steeped in philological Philistinism as Mr. Payne may think. When I first mentioned this famous Colcestrian savant in these pages just over thirty-three years ago on 31st December, 1930—when I also published a sketch showing his famous personal demonstration to the first Queen Elizabeth—I made a gallant attempt to get the name printed correctly as Gilberd. However, the Editor of those days, whose motto was *suaviter in modo, fortiter in re*, would have none of it, but trod firmly on my spelling in that charmingly disarming manner for which he was so well known. However, many years later when I made a brief reference to the learned doctor, I substituted a "d" for the "t." I should add that this was in the reign of a different Editor—not the present one—whom I successfully persuaded.

I deliberately wrote the name as Gilbert in the December issue solely because the scribe whom I was castigating wrote it thus, and I wanted her, if she read my words, to be in no doubt that we were both talking about the same person.

Spelling is sometimes very confusing, and I am afraid that except in Colchester, although incorrect, the spelling "Gilbert" has come to stay, just as has the use of the words "ions" and ionosphere, despite the fact that I once received a letter from a kindly Hellenic reader at the Greek Embassy chiding me for not using the correct plural for the word ion, which is, of course, ionta and for not writing correctly of the iontosphere instead of omitting the "t" which I am afraid we all do and shall continue to do although we never drop the "t" in pantomime.

Electronic Sleep Inducer

ALL of us like to sleep occasionally, and I see in the magazine *Japan Electronics* an interesting description of what is known as an electronic sleep inducer. This has interested me greatly although I have always found television a first-class sleep inducer.

The Japanese electronic sleep inducer runs from three 9-volt batteries or, by means of an adapter, from a.c. mains. The instrument is said to send 19-volt pulses lasting 1mm/sec (*sic*) into the brain by means of saline-saturated pads applied over the eyes and at the back of the neck, "and the repeating rate is 100 cycles," says the writer of the article.

The device is conveniently small; its case measures only $5 \times 3\frac{1}{2} \times 2$in and it weighs 350 grammes.

The great thing about this instrument to my mind is that the restorative effect to our overwrought nerves of two hours of induced sleep is said to be equal to a full night's normal sleep. Obviously this will leave us ample time out of the 24 hours of the day to burn the candle at both ends or to burn the midnight oil as I am doing now while writing my monthly contribution.

NEW

beautifully styled equipment

LEAK HIGH FIDELITY EQUIPMENT breaks fresh ground in 1964 with a completely new look. An exceptionally clean design, functional without severity, attractive without flamboyance, it offers a tasteful presentation which will look well in any cabinet, in any style, in any surroundings. Performance? Unchanged and unquestionably superb!

If you are interested in equipment offering studio quality reproduction and combining faultless presentation with audio engineering to impeccable standards, write now for fully illustrated and detailed literature on the complete new range of LEAK instruments.

World - wide demand for **LEAK-HI-FI**

LOWEST PRICES
HIGHEST QUALITY

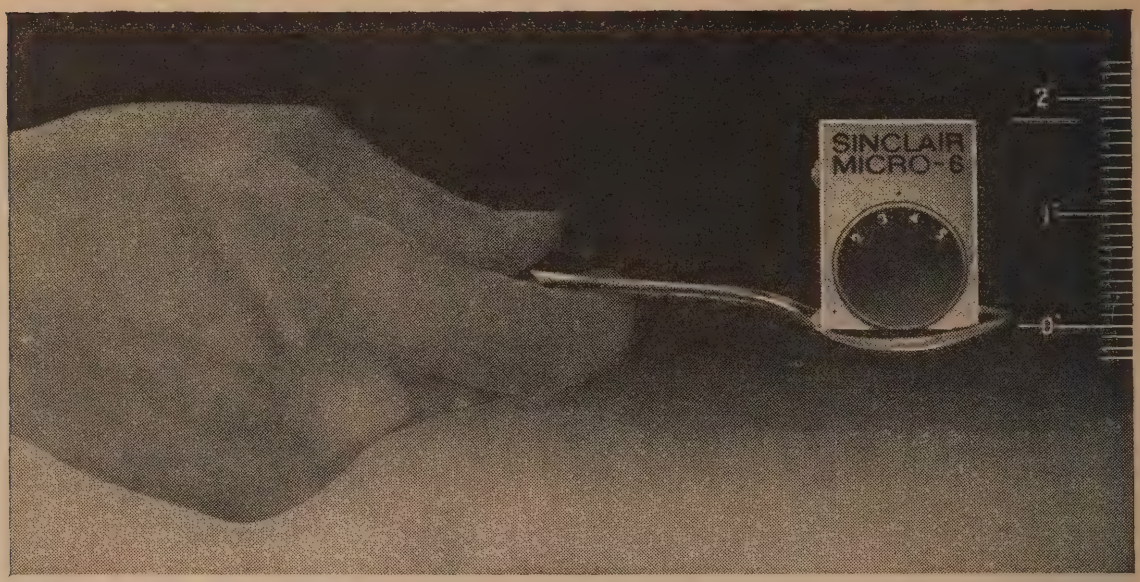
Every LEAK instrument is craftsman-built and is engineered to give the same high quality performance as LEAK equipment supplied to the world's leading broadcasting and recording studios. The world-wide demand keeps the LEAK Organisation fully and efficiently employed and enables studio quality equipment to be sold at reasonable prices.

LEAK ... the first name in High Fidelity

H. J. LEAK & CO. LIMITED
BRUNEL ROAD, WESTWAY FACTORY ESTATE, LONDON, W.3.
Telephone: SHEpherds Bush 1173. Telegrams: Sinusoidal Ealux London

5WW—102 FOR FURTHER DETAILS.

THE SMALLEST



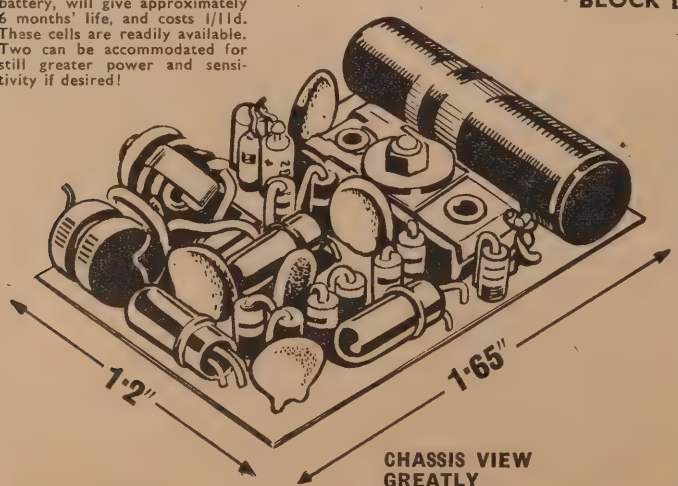
A teaspoonful of power!

SINCLAIR MICRO-6

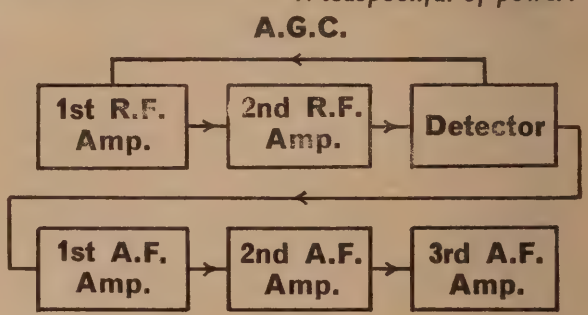
Technical Specification

Two stages of R.F. amplification with double diode detector followed by three stages of audio amplification. The application of negative feed back to all A.F. stages ensures ultra-linear amplification, while amplified A.G.C. applied to the first R.F. stage provides fade-free reception from distant stations such as Luxembourg. Sensitivity is actually superior to that of conventional radios many times larger. The Micro-Six tunes over the entire medium wave-band with increased coverage at the high frequency end to provide improved separation of Continental stations. The set switches on automatically when the high-impedance featherweight earpiece is plugged into the specially designed micro socket. Quality of reproduction is exceptionally good.

POWER REQUIREMENTS— A Mallory Mercury Cell Type ZM.312, the world's smallest battery, will give approximately 6 months' life, and costs 1/11d. These cells are readily available. Two can be accommodated for still greater power and sensitivity if desired!



CHASSIS VIEW GREATLY ENLARGED



BLOCK DIAGRAM OF THE SINCLAIR MICRO-6

SIX STAGE SENSITIVITY ACTUALLY BETTER THAN THAT OF MANY SUPERHETS

•

UNIQUE CIRCUITRY GIVES IMMENSE POWER AND QUALITY

•

PLAYS IN ANY CAR, TRAIN, BUS, PLANE

•

SELF-CONTAINED FERRITE-ROD AERIAL AND BATTERIES

5WW—103 FOR FURTHER DETAILS.

SET IN THE WORLD

A fantastic development in micro-miniaturisation

Just look at the remarkable specification of this latest Sinclair Micro-electronic design—and then look at its size—1⅘in. x 1 3/10in. x ½in. It is almost unbelievable that a set with these tested and proven standards of performance can be contained within a case considerably smaller than a matchbox. Yet it gives superb results from stations all over the medium waveband with a power and sensitivity placing it years ahead of anything even the Japanese have produced. This is a professionally styled set, brilliantly designed by the Sinclair research team to incorporate all the important circuit features of a de-luxe receiver. You will find building the Micro-Six the most absorbing experience you have ever had in electronics. So send for your Micro-Six to-day, and you will have for your pride and pleasure the smallest and most efficient receiver of its kind in the world.

SINCLAIR GUARANTEE

If you are not completely satisfied with your purchase (we are confident that you will be delighted) your full purchase price will be refunded instantly and without question.

ONLY 1⅘" × 1 3/10" × ½"

ALL YOU NEED TO BUILD THIS AMAZING RECEIVER

All parts necessary to build this wonderful receiver, including MAT transistors, diodes, micro-miniature components, printed circuit board, special ferrite-rod aerial, elegant case and knurled dial and featherweight hi-fi quality earpiece together with well presented instructions come only to

59/6

Mallory Mercury Cell, type ZM.312—1/11d. each

FULL SERVICE FACILITIES AVAILABLE TO ALL SINCLAIR CUSTOMERS

SINCLAIR MICRO-6

IMPORTANT NOTICE

The Sinclair Micro-Six is an ultra-small precision designed instrument. As such, previous experience in transistor building will be found helpful. It is imperative that a modern miniature soldering iron be used when building the set.

SINCLAIR RADIONICS LTD

69, HISTON ROAD, CAMBRIDGE

★ *If you do not wish to cut coupon, please mention 'Wireless World' when ordering.*

To SINCLAIR RADIONICS LTD., 69, HISTON ROAD, CAMBRIDGE

Please send parts for building .....Micro-6 Receiver(s) and..... Mallory Cell(s) Type ZM.312 at 1/11 each for which I enclose £.....s.....d.

NAME .....

ADDRESS.....

.....

5WW—104 FOR FURTHER DETAILS.

★ AS SUPPLIED TO:—Government Depts., Technical Colleges and Universities, Motor and Aircraft industry. Industrial Research Laboratories, Education Depts. Film Studios. Ideal for all Commercial and Domestic purposes!

NOTE

SUPER 1" f/1.9 ANASTIGMATIC LENSES Available as shown—at ONLY 12 GNS. each

This Lens has varying aperture from f/1.9 to f/16 and is fully calibrated in focusing mount from infinity to 18in. Standard "C" mount. Highest quality optics and correctly registered for TV work.

KEEP AN EYE ON THINGS

WITH ANOTHER UNBELIEVABLE OFFER OF

"CLOSED-CIRCUIT" TELEVISION CAMERAS

FANTASTIC AT ONLY **£45** COMPLETE

(Carriage and Insurance, 18/-.)

DEFINITELY UNREPEATABLE AT THIS PRICE!

★ **READY ASSEMBLED FOR IMMEDIATE USE — NOTE** These Cameras have been fitted with NEW 2nd Grade Industrial Vidicon Tubes and whilst odd blemishes are existant, picture quality is very good. Thoroughly recommended for EXPERIMENTAL PURPOSES as well as for SECURITY, EDUCATION, and ENTERTAINMENT.

Simplicity in operation, no technical knowledge required, camera plugs direct into aerial socket of your TV set. Full Instructions included. 405 line. R.F. output. Horizontal Resolution 2-2½ Mc/s. Tunable to any Channel in Band 1, i.e., Channels 1-5. Distance between Camera and Sets can be up to several hundred yards. 4 to 6 TV sets can be used off one Camera. Interchangeable lens mounting: "C" mount (16 mm. Cine fitting). 210-240 v. A.C. 50/60 cycles. Weight only 4 lb. Size 4¼ × 3¼ × 8in. Telephoto lenses can be obtained on request. Service facilities; spares readily available if required. These Cameras are ideal for use with Video-Tape Recorders.

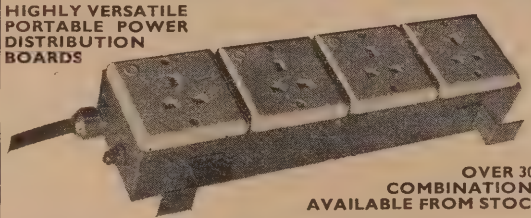
HORNTONS ELECTRONICS

1, NAVIGATION STREET, (Next to Queen's Hotel) BIRMINGHAM 2 Telephone MID 0972

5WW—105 FOR FURTHER DETAILS.

The Lexor "DIS-BOARD" for INSTANT MAINS

HIGHLY VERSATILE PORTABLE POWER DISTRIBUTION BOARDS



OVER 300 COMBINATIONS AVAILABLE FROM STOCK

Full literature and price lists from:

LEXOR ELECTRONICS LIMITED

ALLESLEY OLD ROAD COVENTRY

5WW—106 FOR FURTHER DETAILS.

'CELLOSENE'

CELLULOSE WADDING

AS RECOMMENDED BY GOODMANS FOR RESONANCE DAMPING

40-ply (½" nominal thickness) 36" wide

5 yd. roll **19/-** Carriage 4/-

Sole retail distributors

H. L. SMITH & CO. LTD.

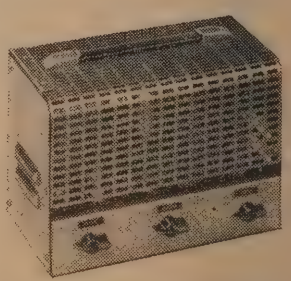
287/289 EDGWARE ROAD, LONDON, W.2

Telephone Paddington 5891/7595

RANGE OF GOODMANS & WHARFEDALE LOUDSPEAKERS ON DEMONSTRATION

AMPERIOR

10WT SOUND REINFORCEMENT



THE PORTABLE PUBLIC ADDRESS SET WITH HI-FI STANDARDS.

ULTRA LINEAR OUTPUT (MAX 12WT) FOR 3, 7 or 15Ω.

INDIVIDUAL INPUTS WITH SEPARATE GAIN CONTROLS FOR MICROPHONE AND GRAM.

HF5/H ... £15 15 0.

HF5/HZ ... £17 5 0. HAVING TWO MICROPHONE INPUTS.

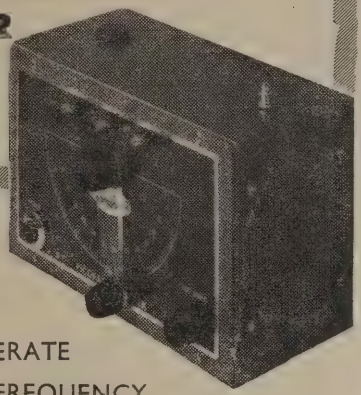
FULL DETAILS OF THIS AND OTHER MODELS BY RETURN.

E. K. ELECTRONICS, (I.A.) LTD., Brotherton, Knottingly, Yorks.

5WW—107 FOR FURTHER DETAILS.

TRANSISTORISED CAPACITANCE METER

0-55 pF
and
0-550 pF



FAST,
ACCURATE
± 3%
SIMPLE TO OPERATE
1.5 Mcs TEST FREQUENCY
AUDIO BALANCE

PRICE ONLY **17 GNS.**

F. C. ROBINSON & PARTNERS LTD

Specialists in Electronic Equipment and Instrumentation

Works & Northern Sales:
COUNCILLOR LANE, CHEADLE, CHESHIRE
Telephone: GATley 6611 (3 lines)

FCR

Southern Sales & Export:
DAVIES HOUSE, 181 ARTHUR RD, WIMBLEDON, LONDON S.W.19.
Telephone: WIMbledon 6386

5WW—108 FOR FURTHER DETAILS.

WHY PAY ££££'s MORE FOR SUPER REGULATION YOU MAY NEVER NEED?

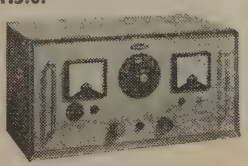
FIXED or VARIABLE High Current outputs of 12-24v. up to 24A standard (other units available to order).

Ripple content negligible. Impedance and regulation equivalent to accumulator performance. Output impedance .4 ohm at 100 c/s. Effective resistance .1 ohm. Inadvertent "short" protection. Long life. Silicon rectifiers, fully smoothed, sustained performance low impedance.

STANDARD APPLICATIONS. OPERATING AND SERVICING TRANSISTORISED EQUIPMENT. MOBILE V.H.F. R/TEL., D.C. MOTORS, RELAYS, INDUSTRIAL POWER, etc., etc. DIRECT FROM A.C. WITHOUT THE USE OF ACCUMULATORS.

PRICES: **£14.16.0 to £131.5.0.**

Please write to department C.3b for DC power supply leaflet.



Valradio
LIMITED

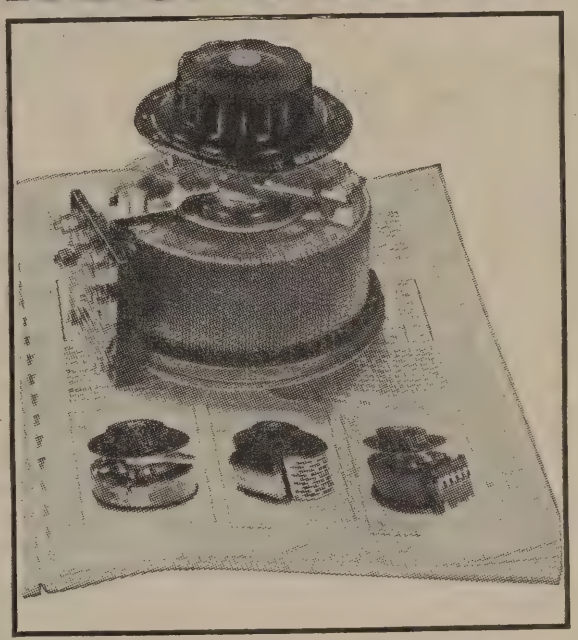
250VRU/30/20

Browells Lane, Feltham, Middx. Tel: Feltham 4242.

Valradio and Stereosonoscope are the registered trademarks of Valradio Ltd.

5WW—109 FOR FURTHER DETAILS.

OVER 300 MODELS OF BERCO REGAVOLTS!



The improved variable transformers with trouble-free brush-gear

More than 30 years of toroidal winding enables us to offer the most comprehensive range of variable transformers in the U.K., designed to meet every industrial and laboratory application. 'REGAVOLT' transformers provide smooth, infinitely variable, reliable control, from zero to line voltage and above, of POWER—HEAT—LIGHT—MOTOR SPEED, etc., and are supplied for single and three phase supplies, HAND OPERATED or MOTOR DRIVEN.

New illustrated technical catalogue No. [illegible]/625 available on request.

Current ratings range from 0.5 to 127 amps. per phase.

BERCO group of companies

THE BRITISH ELECTRIC RESISTANCE CO. LTD.

Queensway · Enfield · Middx · Tel: HOW 2411 Grams: Vitrohm Enfield 31B

5WW—110 FOR FURTHER DETAILS.

R.S.C.

Post Orders to R.S.C. (M/C) Ltd., 5 County Arcade, Leeds, 1. Trade Supplied. Personal Shoppers to any of Branches below

R.S.C.

Post Terms. C.W.O. or C.O.D. No C.O.D. under £1. Postage 2/9 extra on orders under £2. 4/6 extra under £5 unless carr. stated.

R.S.C.

LEICESTER — 32 High Street (Half day Thurs.)

BIRMINGHAM — 6 Gt. Western Arcade (*Opp. Snow Hill Stn.*) (No half day)

SHEFFIELD — 13 Exchange Street (Castle Market Bldgs.) (Half day closing Thursday)

HULL — 51 Savile St.

M'CHESTER — 8-10 Brown Street (Market Street) (No half day)

LIVERPOOL — 73 Dale Street (*mins. from Exchange Stn. 8 mins. from Lime St. Stn.* Half day Wed.)

LEEDS — 5-7 County Arcade Arcade Briggate, Leeds, 1 No half day

BRADFORD — 56 Morley Street (above Alhambra) Half day Wed.

DERBY

26 Osmaston Rd. The Spot (Half day Wed.)

HI-FI 10 WATT AMPLIFIERS

BRAND NEW CARTONED MANUFACTURER'S DISCONTINUED. MODEL. **£7.19.6** Carr. 4/6.

A REMARKABLE OPPORTUNITY.

Push-pull output. Latest high efficiency Mullard valves. Dual separately controlled inputs for mike and gram. Separate bass and treble controls. High-sensitivity. Output for 3 ohm or 15 ohm loudspeaker. Guaranteed, tested and in perfect working order. For 200-250 A.C. mains.

LINEAR TAPE PRE-AMPLIFIER Type LP/1. Switched negative feedback equalisation. Positions for Record 1½in. 3¾in., 7½in. and Playback. EM84 Recording Level indicator. Designed primarily as the link between Collaro Tape Transcriptor and high fidelity amplifier but suitable almost any Tape Deck. **9 GNS.** Send S.A.E. for leaflet.

EXTENSION SPEAKERS, in handsome, walnut veneered cabinets. All standard 2-3 ohms, 6½in. **29/9.** 8in. **35/9.**

LINEAR L45 MINIATURE 4/5 W. QUALITY AMPLIFIER. Suitable for use with any record playing unit and most microphones. Negative feedback 12 D.B. Bass and treble controls. For A.C. mains input of 200-250 v. 50 c.p.s. Output for 2/3 ohms speaker. Three miniature Mullard valves. Size only 6×5×5½in. high. Chassis fully isolated from mains. Guaranteed 12 months. Only **£5.19.6** Or Deposit **22/-** and 5 monthly payments of **22/-.** Send S.A.E. for leaflet.

CABY MULTIMETERS. M1. Sensitivity 2,000 ohms per volt. A.C. and D.C. **54/-.** A10. Basic meter sensitivity 155 microamp. A.C. and D.C. ranges. **£4/17/6.** B20. Sensitivity up to 10,000 ohms per volt A.C. and D.C. **£6/10/-.** TMK500 30,000 ohms per volt. A.C. and D.C. **£8/19/6.** Send S.A.E. for leaflet.

SUPERHET RADIO FEEDER UNIT

Design of a high quality Radio Tuner (specially suitable for use with any of our Amplifiers). Triode Heptrode. F/changer is used. Pentode I.F. and double Diode Second Detector. Delayed A.V.C. W. Ch. Sw. incorporates Gram. position. Controls are Tuning, W. Ch. and Vol. Simple alignment instructions. Only 250 v. 15 mA. H.T. and L.T. or 6.3 v. 1 amp. required from amplifier. Size of unit approx. 9-6-7in. high. Send S.A.E. for illustrated leaflet. Total building cost of **£4/15/-.** Point-to-point wiring diagrams and instructions **2/6.**

STOCKISTS OF ARMSTRONG CHASSIS, GOODMANS, W.B. and FANE SPEAKERS, LINEAR, LEAK, VERDIK, ROGERS, DULCI AMPLIFIERS, GARRARD and GOLDRING T/TABLES CASH or H.P.

THE SKYFOUR T.R.F. RECEIVER

A design of a 3-valve 200-250 v. A.C. mains L. and M. wave T.R.F. receiver with selenium rectifier. It employs valves 6K7, SP61, 6V6 and is specially designed for simplicity in wiring. Sensitivity and quality are well up to standard. Point to Point wiring diagram, instructions and parts list **1/9.** This receiver can be built for a maximum of **£4/19/6** including veneered walnut cabinet.

ACOS GP67-2G HI-FI Crystal Cartridges with sapphire stylus. Standard replacement for Garrard, B.S.R. and Collaro. Only **16/9.** Acos Stereo/Monaural **35/9.** Ronette Stereo/Monaural **39/9.**

Only 3 pairs of soldered joints plus mains.

AUDIOTRINE HI-FI TAPE RECORDER KIT

Build a high quality recorder in the £70 class for only

25½ GNS. Carr. 17/6.

Can be assembled in 1 hour

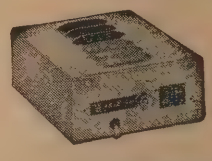
OR DEPOSIT **£2.13.9** and 12 monthly payments of 44/-. Cash price if settled in 3 months.

INCORPORATING THE LATEST COLLARO STUDIO TAPE TRANSCRIPTOR THE AUDIOTRINE HIGH QUALITY TAPE AMPLIFIER. A HIGH FLUX 7×4in. LOUDSPEAKER. Reel of Best Quality TAPE, Spare Tape Spools, a Portable Cabinet, size approx. 14½×15×8½in., finished in durable and attractive duo tone Policrome and connection diagram for wiring amplifier to transcriptor.

FEATURES INCLUDE:

★ 3-SPEEDS. ★ FREQUENCY RESPONSE 50-11,000 c.p.s. ★ SWITCHED NEGATIVE FEEDBACK EQUALIZING FOR EACH SPEED ★ OUTPUT 4 WATTS ★ MAGIC EYE RECORDING LEVEL INDICATOR ★ 3 MOTORS. ★ Fast rewind ★ TAPE MEASURING AND CALIBRATING DEVICE ★ TAKES FULL 7in. DIAMETER REELS OF TAPE ★ NEGLIGIBLE HUM ★ ENTIRELY EFFECTIVE AUTOMATIC ERASURE. Send S.A.E. for leaflet.

R.S.C. BATTERY TO MAINS CONVERSION UNITS



Type BM1. An all-dry battery eliminator. Size 5½×4½×2in. approx. Completely replaces batteries supply 1.4v. and 90 v. where A.C. mains 200-250 v. 50 c/s. is available. **Suitable for all battery portable receivers requiring 1.4 v. and 90 v.** This includes latest low consumption types. Complete kit with diagram **39/9** or ready for use **46/9** Type BM2. Size 8×5½×2¾in. Supplies 120 v. 90 v. and 60 v. 40 mA. and 2 v. 0.4 a. to 1 amp., fully smoothed **THEREBY COMPLETELY REPLACING BOTH H.T. BATTERIES AND L.T. 2 v. ACCUMULATORS** when connected to A.C. mains supply 200-250 v. 50 c/s. SUITABLE FOR ALL BATTERY RECEIVERS normally using 2 v. accumulator.

Complete kit with diagrams and instructions. **49/9** or ready for use **59/6.**

POWER PACK KITS. Only **19/11.** Fully smoothed H.T. output of 250 v. 60 mA. and L.T. supply of 6.3 v. 1.5 amp. Consisting of Double Wound Mains Transformer 230/250 v. 50 c.p.s. A.C. primary. Selenium Rectifier. Smoothing Choke. Double Electrolytic Condenser. Aluminium Chassis and Circuit.

LONDON

238, Edgware Road, W.2.

Two New Branches Opening In Early March

GLASGOW

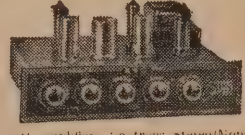
326 Argyle Street

SENSATIONAL STEREO OFFER

Complete kit of parts to construct a 3+2-watt good quality stereo amplifier providing realistic reproduction. Suitable all stereo pick-up heads. Ganged vol. and tone controls. Pre-set balance. For 200-250 v. A.C. mains only. Fully isolated chassis.

Or including Stereo Head **19/9** extra. **4 GNS.** Carr. 4/6.

R.S.C. STEREO/TEN HIGH QUALITY AMPLIFIER KIT



Valves EZ81, ECC 83, ECC83, EL84, EL84. Separate bass and treble controls giving "cut" and "boost." Sensitivity 50 mv, 5 watts high quality output on each channel. Can be used as straight 10 watt amplifier. Controls: Stereo/Monaural switch, ganged volume, ganged trebic, ganged bass and balance. Output for 3 ohms speakers. Point-to-Point wiring diagrams and instructions. Illustration full wiring details and priced parts list **1/9.** Or supplied assembled and tested 59/6 extra. **8 GNS.** Carr. 7/9.

R.S.C. 3 WATT GRAM AMPLIFIER KIT

All parts to construct a very compact, highly sensitive amplifier suitable for any type of single or autochange player. Size 12×2½×2½in. Chassis is isolated. Mains transformer for 200-250 v. A.C. mains. Output for 2-3 ohm speaker. Volume and tone control with mains switch. ONLY **39/9**

GL3A MINIATURE 3 WATT GRAM AMPLIFIERS. For 200-250 v. 50 c.p.s. A.C. mains. Overall size only 11½ × 2½×2½in. Fitted Vol. and Tone Control with mains switch. Designed for use with any kind of single player or record changer unit. Output for 2-3 ohms speaker. Guaranteed 12 months. Only **59/6.**

SELENIUM RECTIFIERS

L.T. Types	
2/6 v. ½ a. H.W.	1/9
6/12 v. ½ a. H.W.	2/9
Following F.W. (Bridge)	
6/12 v. 1 a.	3/11
6/12 v. 2 a.	6/11
6/12 v. 3 a.	9/9
6/12 v. 4 a.	12/3
6/12 v. 5 a.	14/6
6/12 v. 6 a.	15/6
6/12 v. 10 a.	25/9
6/12 v. 15 a.	35/9

H.T. Types H.W.	
120 v. 40 mA.	3/9
250 v. 50 mA.	3/11
250 v. 60 mA.	4/11
250 v. 80 mA.	6/11
250 v. 250 mA	11/9
Contact cooled	
250 v. 60 mA. H W.	5/11
250 v. 70 mA. H.W.	7/11
F.W. (Bridge) Types	
250 v. 50 mA.	8/11
250 v. 75 mA.	10/11

R.C.A. 20-WATT RE-ENTRANT SPEAKERS. Matching for 3, 15, 200 and 600 ohms only **4 GNS.**

TRANSISTOR SALE

Mullard OC71 3/9. OC45 4/11 OC44 4/11, OC72 4/9, OC81 4/11. OC171 8/9. Ediswan XA101, XA112 XB113, XB104, XC101A 3/9 ea. Postage 6d. for up to 3 Transistors.

JASON F.M. TUNER

Type FMT1. All parts including Dial, Escutcheon, Punched Chassis & Valves Power supply required 180 v. 25 mA and 6.3 v. 1.5 a. **£7/19/6**

Type FMT2 **£9/17/6**

R.S.C. Battery Chargers & Kits for 200-230-250 v. 50 c/s. A.C. Mains Guaranteed 12 mths.

HEAVY DUTY KIT

6/12 v. variable charge rate up to **6 amps.** Consisting of Mains Trans., F.W. (Bridge), Selenium Rectifier, 0-7 amp. meter. Variable Charge Selector. Fuses, fuse - holders, panels, plugs and circuit. Only **59/9.** Post 4/6.

CHARGER TRANSFORMERS

200-230-250 v. 50 c/s.

0-9-15 v. 1½ a.	12/9
0-9-15 v. 2½ a.	14/9
0-9-15 v. 3 a.	16/9
0-9-15 v. 5 a.	19/9
0-9-15 v. 6 a.	23/9
0-9-15 v. 8 a.	28/9

BATTERY CHARGER KITS

Consisting of Mains Transformer, F.W. Bridge, Metal Rectifier, well ventilated steel case. Fuses, fuse-holders, grommets, panels clips and circuit. Carr. 3/9 extra.

6 v. or 12 v. 1 amp.	22/9
As above with ammeter	28/9
6 v. 2 amps.	19/9
6 v. or 12 v. 2 amps.	25/9
6 v. or 12 v. 2 amps.	35/9
(inclusive of ammeter)	
6 v. or 12 v. 4 amps., with variable charge rate selector and ammeter	52/9

HEAVY DUTY 14 AMP KIT

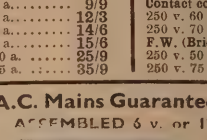
at 12 v. (or 24 v. at 7 amp.). Consists of Transformer, Rectifier, Variable Resistor, Ammeter Fuses. Terminals. Stove Enamelled Case and Circuit. Only **10 GNS.** Carr. 15/-

ASSEMBLED CHARGERS

6-12v.1a. less meter 27/9

6-12 v. 2 amp Fitted Ammeter and selector plug for 6 v. or 12 v. Louvred metal case, finished attractive hammer blue. Ready for use with mains and output leads. Double Fused. Only **39/9** Carr. 3/9.

ASSEMBLED 6 v. or 12 v 4 amps.



Fitted Ammeter and variable charge selector. Also selector plug for 6 v. or 12 v. charging. Double fused. Well ventilated steel case with blue hammer finish. Ready for use with mains and output leads. **59/9** Carr. 4/6.

Or Deposit **12/-** and 5 monthly payments of **12/-.** As above but for 6 amp. charging. **4 GNS.** Carr. 5/- or Deposit **16/-** and 5 monthly payments of **16/-.**

D.C. SUPPLY KITS.

Suitable for electric trains. Consists of mains trans. 200-250 v. 50 c.p.s. 12 v. lamp, selenium rect. (F.W. Bridge): 2 fuse-holders, 2 fuses change direction switch variable speed regulator, partially drilled steel case and circuit. Very limited number **29/11.**

EX GOVT. SELENIUM RECTIFIERS 19/9

12 v. 15 amp. F.W. (Bridge). Only

EX. GOVT. SMOOTHING CHOKES

60 ma. 10 h. 400 ohms **3/11.** 100 mA. 10 h. ohms **6/9.** 150 mA. 10 h. 100 ohms **10/11.** 120 mA 12 h. 100 ohms 9/8. 200 mA. 5 10 h. 100 ohms **11/9.** 250 mA. 5 h. 50 ohms **10/9.**

TANNOY 8 WATT RE-ENTRANT LOUDSPEAKERS. 8 ohms for workshop, factory or outdoor use. **25/9** ea.

VALVES

Full range. Keen prices.

CHARGER AMMETERS

0-1½ a. 0-3 a., 0-7a 8/9

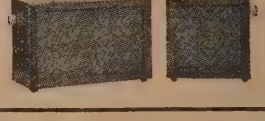
HEAVY DUTY SELENIUM RECTIFIERS

24 v. 20 amp. Full wave (bridge). **49/9** Brand new.

R.S.C. POWER PACKS 200-250 v. A.C. Completely enclosed in louvred enamelled case, 8×5½×2½in. Output fully smoothed 250 v. 60 mA. and 6.3 v. 2 a. **39/9.**

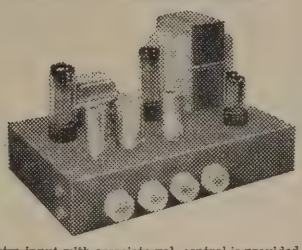
R.S.C. BABY ALARM or INTERCOM. UNIT KIT

For 200-250 v. A.C. mains. Includes all parts, diagrams and instructions. High sensitivity. Completely safe. Controllable at either end. Housed in two cabinets of pleasing design **89/6.** Carr. 5/-. Or assembled and tested **6 gns.**



R.S.C. A10 30 WATT AMPLIFIER

HIGH FIDELITY ULTRA LINEAR PUSH-PULL OUTPUT



SIX VALVES (EF86, EF86, ECC83, 807, 807, GZ34. Tone Control Pre-Amp. stages are incorporated. Sensitivity is extremely high. Only 12 millivolt minimum input is required for full output. **THIS ENSURES THE SUITABILITY OF ANY TYPE OR MAKE OF MICROPHONE OR PICK-UP.** Separate Bass and Treble controls give both "lift" and "cut" with smaller tone correction for long playing records. An extra input with associate vol. control is provided so that two separate inputs such as "mike" and gram, etc., can be simultaneously applied for mixing purposes. **AN OUTPUT SOCKET WITH PLUG IS INCLUDED FOR SUPPLY OF 300 v. 20mA and 6.3 v. 1.5 A. FOR A RADIO FEEDER UNIT.** Price in kit form with easy to follow wiring diagram.

ONLY **11 Gns.** Or factory built using latest EL34 output valves and with 12 months guarantee. **14 GNS. TERMS ON ASSEMBLED UNITS.** Carr. 10/-. **DEPOSIT 33/9** and 9 monthly payments of **33/9.**

Protective Cover **19/9.** Type 807 output valves are used with High Quality Sectionally Wound output transformer specially designed for Ultra Linear operation. Negative feedback of 20 D.B. in main loop. **CERTIFIED PERFORMANCE FIGURES ARE EQUAL TO MOST EXPENSIVE UNITS AVAILABLE.** Frequency response ±3 D.B. 30-20,000 c/s. Tone Controls ± 12 D.B. at 50 c/s. +12 D.B. to −6 D.B. at 12,000 c/s., hum and noise 70 D.B. down. Good quality reliable components used. Chassis finish blue hammer. Overall size 12×9×9in. approx. Power consumption 150 watts. For A.C. mains 200-250 v. 50 c/s. Output for 3 and 15 ohms speakers. **EQUALLY SUITABLE FOR THE CONNOISSEUR OR FOR LARGE HALLS, CLUBS OR OUTSIDE FUNCTIONS, IDEAL FOR USE WITH MUSICAL INSTRUMENTS, SUCH AS STRING BASS, ELECTRONIC ORGAN, GUITAR, etc. FOR DANCE BANDS, GARRISON THEATRES, etc., etc. We can supply Microphones, Speakers, etc., at keen cash prices or on terms with amplifiers. EXPORT ENQUIRIES INVITED.**

LOUDSPEAKERS. 2½in. to 18in. at keen prices. 12in. 6-8 watt 3 ohms **29/11.** 12in. 10 watt 12,000 lines 3 ohms or 15 ohms **59/9.** **TWEETERS.** 4in. R.A. 3 ohms **25/9.** R.A. 15 ohms **25/9.** W.B. 15 ohms **31/9.** Fane 15 ohms, Pressure type **£3/15/-.**

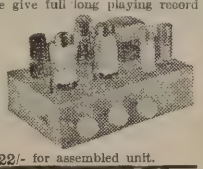
FANE HEAVY DUTY HI-FIDELITY SPEAKERS

12in. 15 ohms.	**Cast chassis**	Exceptionally robust 2in. diam.	Voice Coil Assemblies.
	12/10 20watts . 5 gns.	12/10A 20watts . . 6 gns.	
	12/12 20watts 6 gns.	12/12A 20watts **£7 19 6**	
	12/14 22watts 9 gns.	12/14A 22watts 10 gns.	
	12/17 25watts 11 gns.	12/17A 25watts 12 gns.	
15in. 15 ohms.	**Cast chassis.**	Exceptionally robust 2in. diam.	Voice Coil Assemblies.
	15/12 20w. . 12 gns.	15/12A 20w. . 13 gns.	
	15/14 27w. . 14 gns.	15/14A 27w. . 15 gns.	
	15/17 35w. . 16 gns.	15/17A 35w. . 17 gns.	

"A" indicates dual cone type, 30-17,000 c.p.s. Send S.A.E. for leaflets. Terms available.

R.S.C. A5 4-5 WATT HIGH GAIN AMPLIFIERS

A highly sensitive 4-valve quality amplifier for the home, small club, etc. Only 50 millivolts input is required for full output so that it is suitable for use with the latest high fidelity pick-up heads in addition to all other types of pick-ups and practically all makes. Separate Bass and Treble controls are provided. These give full long playing record equalisation. Hum-level is negligible being 71 D.B. down. 15 D.B. negative feedback is used. H.T. of 300 v. 26 mA. and L.T. of 6.3 v. 1.5 a. is available for the supply of a Radio Feeder Unit or Tape Deck pre-amplifier. For A.C. mains input of 200-250 v. 50 c/s. Output for 2-3 ohms speaker. Chassis is not alive. Kit is complete in every detail and includes fully punched chassis (with baseplate) with the blue hammer finish and point-to-point wiring diagrams and instructions. Exceptional value at only **£4/15/-** or assembled ready for use **25/-** extra, plus 3/6 carriage. Or deposit **22/-** and five monthly payments of **22/-** for assembled unit.



R.S.C. TRANSFORMERS Fully Guaranteed. Interleaved & Impregnated.

MAINS TRANSFORMERS. Primaries 200-250 v. 50 c/s.

FULLY SHROUDED. UPRIGHT MOUNTING.

250-0-250v, 60 mA., 6.3 v. 2 a., 0-5-6.3 v. 2a. 2½-3-3in.	17/11
250-0-250 v. 100mA., 6.3 v. 4 a., 0-5-6.3 v. 3 a.	27/11
300-0-300 v. 100 mA., 6.3 v. 4 a., 0-5-6.3 v. 3 a.	27/11
300-0-300 v. 130 mA., 6.3 v. 4 a. c.t., 6.3 v. 1 a. For Mullard 510 Amplifier	33/9
350-0-350 v. 100 mA., 6.3 v. 4 a., 0-5-6.3 v. 3 a.	33/11
425-0-425 v. 200 mA., 6.3 v. 4 a., c.t., 5 v. 3 a.	55/9
425-0-425 v. 200 mA., 6.3 v. 4 a., 6.3 v. 4 a., 5 v. 3 a.	59/9
450-0-450 v. 250 mA., 6.3 v. 4 a. C.T. 5 v. 3 a.	69/9

TOP SHROUDED DROP-THROUGH TYPE

260-0-256 v. 70 mA., 6.3 v. 3 a., 0-5-6.3 v. 2 a.	17/9
250-0-250 v. 100 mA., 6.3 v. 3.5 a.	19/9
250-0-250 v. 100 mA., 6.3 v. 2 a., 6.3 v. 1 a.	21/9
350-0-350 v. 80 mA., 6.3 v. 2 a. 0-5-6.3 v. 2 a.	18/11
250-0-250 v. 100 mA., 6.3 v. 4 a., 0-5-6.3 v. 3 a.	26/9
300-0-300 v. 100 mA., 6.3 v. 4 a., 0-5-6.3 v. 3 a.	26/9
300-0-300 v. 130 mA., 6.3 v. 4 a., 0-5-6.3 v. 1 a., suitable for Mullard 510 Amplifier	29/9
350-0-350 v. 100 mA., 6.3 v. 4 a., 0-5-6.3 v. 3 a.	26/9
350-0-350 v. 150 mA., 6.3 v. 4 a., 0-5-6.3 v. 3 a.	29/9
425-0-425 v. 200 mA., 6.3 v. 4 a., 2 v. 3 a.	55/9

MIDGET CLAMPED TYPE. Primaries 200-250 v.

250-0-250 v. 60 mA., 6.3 v. 2 a., 2½×2½×2½in.	12/9
250 v. 60 mA., 6.3 v. 2 a., Size 2½×2½×2½in.	11/9

FILAMENT TRANSFORMERS 12 v. 1 a. 7/9; 6.3 v. 1.5 a. 5/9; 6.3 v. 3 a. 9/11; 6.3 v. 2 a. 7/6; 6.3 v. 6 a. 17/9; 12v. 3 a. or 24 v. 1.5a 17/9

AUTO (Step Up/Step Down) TRANSFORMERS

50-80 watts 110-120 v./230-250 v.	13/9
150 watts 110-120 v./200-250 v.	27/9
250 watts 110-120 v./200-250 v.	39/9

W.B. "STENTORIAN" HIGH FIDELITY P.M. SPEAKERS HF1012. 10 watts rating. Where a really good quality speaker at a low price is required, we highly recommend this unit with an amazing performance. **£4/7/6.** Please state whether 3 ohm or 15 ohm required.

BASS REFLEX CABINET. Designed for above speaker. Acoustically lined and ported. Polished walnut veneer finish. Size 18×12×10in. Strongly made. Handsome appearance. Ensures superb reproduction for only **£3/19/6.**

OUTPUT TRANSFORMERS

Midget Battery Pentode 66.1 to 3Ω, etc.	4/6
Small Pentode, 5,000Ω to 3Ω	4/6
Standard Pentode 5,000Ω to 3Ω	5/9
Standard Pentode 7,000Ω to 3Ω	5/9
Push pull 8 watts EL84 to 3Ω	8/9
Push pull 8 watts EL84s to 15Ω	8/9
Push pull 10-12 watts 6V6 to 3Ω or 15Ω	16/9
Push pull 10-12 watts to match 6V6 to 3-5-8 or 15	17/9
Push pull EL84 to 3 or 15Ω 10-12 watts	17/9
Push pull Ultra Linear for Mullard 510, etc.	29/9
Push pull 15-18 watts. sectionally wound 6L6. KT66, etc., for 3 or 15Ω	£ 9/9
Push pull 20 watt high-quality sectionally wound. EL34, 6L6, KT66, etc. to 3 or 15Ω fully shrouded	47/9

MICROPHONE TRANSFORMERS

120-1 High quality, clamped	8/9

SMOOTHING CHOKES

250mA., 5 H., 100Ω	11/9
150 mA., 7-10H., 250Ω	11/9
100 mA., 10 H., 200Ω	8/9
80 mA., 10 H., 350Ω	5/6
60 mA., 10 H., 400Ω	4/11
1 amp. 0.5Ω L.T. type	6/6

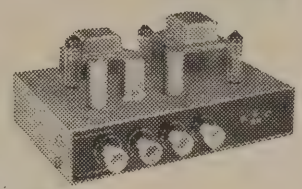
AUDIOTRINE HIGH FIDELITY SPEAKER SYSTEMS

Designed to provide a smooth frequency response from 40-20,000 c.p.s. consisting of 12in. 12,000 line 15 ohm speaker. Crossover Unit and Tweeter. Highly recommended for use with any High Fidelity Amplifier. **10 Watt Unit £4/19/6** or Deposit **11/3** and nine monthly payments of **11/3. 20 Watt Unit £6/19/9** or Deposit **15/9** and nine monthly payments of **15/9.**

B.S.R. MONARDECK TAPE DECK. Speed 3¾in. per sec. As fitted to most leading make Tape Recorders. Brand new **£6/19/6.** Carr. 5/-. Suitable Portable Cabinets to take Deck and Tape Amplifier **39/9.**

R.S.C. A11 12-14 WATT AMPLIFIER

HIGH FIDELITY PUSH-PULL ULTRA LINEAR OUTPUT "BUILT-IN" PRE-AMP STAGES



Two input sockets with associated controls allow mixing of "mike" and gram. as in A.10 High sensitivity. Includes 5 valves ECC83, ECC83, EL84, EL84, EZ81. High Quality sectionally wound output transformer specially designed for Ultra Linear operation and reliable small condensers of current manufacture. INDIVIDUAL CONTROLS FOR BASS AND TREBLE "Lift" and "Cut". Frequency response ± 3 D.B. 30-30,000 c/s. Six negative feedback loops. Hum level 60 D.B. down. ONLY 23 millivolts INPUT required for FULL OUTPUT. Suitable for use with all makes and types of pick-ups and microphones. Comparable with the very best designs.

For **STANDARD or LONG PLAYING RECORDS**. For **MUSICAL INSTRUMENTS** such as **STRING BASS, GUITARS, etc. OUTPUT SOCKET** with plug provides 300 v. 30 mA. and 6.3 v. 1.5 a. For supply of a **RADIO FEEDER UNIT.** Size approx. 12×9×7in. For A.C. mains 200-250 v. 50 c/s. Output for 3 and 15 ohms speakers. Kit is complete to last nut. Chassis is fully punched. Full instructions and point-to-point wiring. **8 Gns.** Carr. Diagrams supplied (or factory built **51/6** extra) ONLY 10/-. If required louvred metal covers with 2 carrying handles can be supplied for **18/9. TERMS ON ASSEMBLED UNITS. DEPOSIT 24/9 and 9 monthly payments of 24/9.** Send S.A.E. for illustrated leaflet detailing ready-to-assemble Cabinets, Speakers, Microphones, etc. with cash and credit terms.

R.S.C. BASS-MAJOR 30 WATT GUITAR AMPLIFIER

A Multi-Purpose High Fidelity, High Output Unit for Vocal and instrumentalist Groups. Incorporating two 12in. heavy duty 25-watt high flux (17,000 lines) loudspeakers with 2in diameter pole pieces (total flux 220,000 lines). Designed for efficiently handling more than full output of amplifier at frequencies down to 25 c.p.s. One speaker has an aluminium speech coil and dual cone to extend frequency range up to 17,000 c.p.s. Heavily made cabinet of convenient size 24×21×14in. has an exceptionally attractive covering in two contrasting tones of Vynair. For 200-350 v. 50 c.p.s. A.C. mains operation. EMINENTLY SUITABLE FOR BASS, LEAD or RHYTHM GUITAR AND ALL OTHER MUSICAL INSTRUMENTS. Four jack socket inputs and two independent vol. controls for simultaneous connection of up to four instrument pick-ups or microphones. Separate bass and treble controls providing more than adequate "Boost" or "Cut" Level frequency response throughout the audible range.

39½ Gns Carr. 17/6. Or DEPOSIT **£4/3/-** and 12 monthly payments of **£3/9/11.**

Superior to units at twice the cost. Send S.A.E. for illustrated leaflet.

R.S.C. JUNIOR GUITAR AMPLIFIER 5-watt high quality output. Separate base and treble "cut" and "boost" controls. Sensitivity 15 m.v. Two high impedance inputs. 10 in. loudspeaker. Handsome strongly made cabinet (size 14×14×7in. approx.) finished in attractive and durable polychrome. 200-250 A.C. mains operation. **£8/19/6** Carr. Send S.A.E. for leaflet. 7/6. Or DEPOSIT £1 and nine monthly payments of £1.

LINEAR TREMOLO/PRE-AMP. UNIT Designed for introducing the Tremolo effect to any amplifier fitted with a reserve power supply point for smoothed H.T. and 6.3 v. A.C. This applies to practically all amplifiers of our manufacture and to those of several other manufacturers. The unit plugs into power supply point and any input socket of amplifier. Controls are Speed (frequency of interruptions). Depth (for heavy or light effect). Volume, and Switch. Three sockets are for 2 inputs and Foot Switch. Only **4 Gns.**

MICROPHONES. Full range from 14/9. Also Desk & Floor Stands.

R.S.C. SENIOR 15 WATT LEAD OR RHYTHM GUITAR AMPLIFIER. High-fidelity push-pull output. Separate bass and treble "cut" and "boost" controls. Twin separately controlled inputs so that two instruments or "mike" and pick-up can be used at the same time. A heavy duty 20 watt high flux 12in. loudspeaker with cast chassis is used. Cabinet is well made and finished as Junior Model. Size approx. 18×18×8in. **18 Gns.** Or DEPOSIT **35/-** and 12 monthly payments **35/-.** Carr. 10/- Send S.A.E. for leaflet.

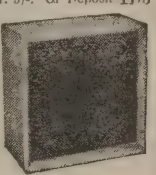
LOUDSPEAKERS IN CABINETS

12in. 10 WATT. Walnut Veneered Cabinet size 15×15×8in. approx. High quality 12in. 10 watt 12,000 line Speaker, 3 ohms or 15 ohms. **£4/19/6.** Carr. 5/-. Or Deposit **11/3** and nine monthly payments **11/3**

12in. 20 WATT. High Quality 15,000 line Speaker 15 ohms in Cabinet finished as above. Size 18×18×8in. **£7/19/6.** Carr. 7/9 or Deposit **17/9** and 9 monthly payments of **17/9.**

15in. 30 WATT. Heavy Duty High Flux Speaker. Suitable for BASS GUITAR. Cabinet 24×21×15in. Heavy construction covered in attractive Rexine and Vynair in two contrasting tones of grey. Only **19½ GNS.** Or Deposit **37/6** and 12 monthly payments **37/6.**

15in. 50 WATT. 14,000 line speaker with 3in. diameter speech coil. 15 ohms Impedance, in Substantial Two-tone Rexine and Vynair covered cabinet of pleasing appearance. Acoustically lined. IDEAL FOR BASS GUITAR. Size 30×24×16in. approx. ONLY **29 Gns.** Or Deposit **£3/15/-** and twelve monthly payments **50/-.**



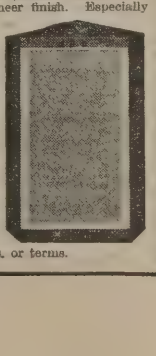
R.S.C. STANDARD BASS REFLEX CABINET. For 12in. Loudspeakers, acoustically lined and ported. Size 20in. × 14in.×13in. Beautiful walnut veneer finish. Especially recommended for use with Speaker system below, **£5/19/6.** Set of four legs can be supplied with brass ferrules for 19/6.

AUDIOTRINE CORNER CONSOLE CABINETS. Strongly made. Beautiful polished walnut veneered finish. Pleasing design.

JUNIOR MODEL. To take up to 8in. speaker. Size approx. 20×11×8in. Only **49/9.**

STANDARD MODEL. To take up to 10in. speaker. Size 27×18×12in. **£4/11/9.**

SENIOR MODELS. To take up to 12in. speaker and with Tweeter cut-out. Size approx. 30×30×15in. (Recommended for use with Audiotrine speaker system). **7 Gns.** or terms.



AVO

STOCKISTS

MULTIMINOR MK. IV

MODEL 8 MK. II

REPAIR SERVICE 7-14 DAYS

We specialise in repair, calibration and conversion of all types of instruments, industrial and precision grade to BSS.89.

Release notes and certificates of accuracy on request.

Suppliers of Elliott, Cambridge and Pye instruments.

LEDON INSTRUMENTS LTD

76-78 DEPTFORD HIGH STREET, LONDON, S.E.8

TEL.: TIDeway 2689

E.I.D. & G.P.O. APPROVED **CONTRACTOR TO H.M. GOVT.**

5WW—113 FOR FURTHER DETAILS.

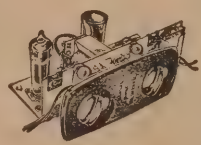
BRAND NEW AM/FM (V.H.F.) RADIOGRAM CHASSIS AT £13.13.0 (CARRIAGE PAID)

A.C. ONLY. Chassis size 15 × 6¾ × 5¾in. high. New manufacture. Dial 14½ × 4in., in 2 colours, predominantly gold. Pick-up, Extension Speaker. Ae., E., and Dipole Sockets. Five "piano" push buttons — OFF L.W., M.W., F.M. and Gram. Aligned and tested. With all valves and O.P. Transformer. Tone Control fitted. Covers 1,000-1,900 M.; 200-500 M; 88-98 Mc/s. Valves EZ80 rect., ECH81, EF89, EABC80, EL84, ECC85. Speaker and Cabinet to fit chassis (table model), **47/6** (post 5/-). 10 × 6in. ELLIPTICAL SPEAKER **25/-** to purchasers of this chassis. **TERMS:** (Chassis) **£3/10/-** down and 5 monthly payments of **£2/4/-** or with Cabinet and Speaker **£4** down and 6 monthly payments of **£2/4/-**.

ALTERNATIVE DESIGN. LW 1,000-2,000M; SW 17-50M (6-17 mc/s); MW 200-550M; VHF 87-100 mc/s; gram position. Dial dark brown and gold. Otherwise similar to above chassis. Price **£15/15/-** (carr. paid), terms **£3/10/-** down and 6 monthly payments of **£2/4/-**.

STEREO CONVERTER UNIT

Converts existing Radiogram to play stereo records. Chassis 6¾ × 2¾ × 4in. overall height. Mains and O.P. trans., metal rect., ECL 82 valve and all screws, panels, etc. Moulded front escutcheon, fully built, brand new, only extras needed speaker and stereo cartridge. Full instruction leaflet. Two of these units form the basis of an ideal stereo player. Limited quantity at **39/6** (5/6 P. & P.).



BATTERY ELIMINATOR

For 4 low consumption valves (96 range), 90 v. 15 mA. and 1.4 v. 125 mA., **45/-** (4/- post). 200-250 v. A.C. Also for 250 mA. 1.4 v. and 90 v. 15 mA. at same price. Two units to replace existing batteries.

TERMS AVAILABLE ON ITEMS OVER £5.

Send 6d. for 20-page illustrated catalogue. All New Goods. Delivered by return. (C.O.D. 2/- extra).

ALL ITEMS GUARANTEED 12 MONTHS. VALVES 3 MONTHS.

GLADSTONE RADIO

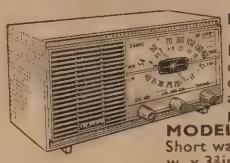
"SCALA," CAMP ROAD, FARNBOROUGH, Hants., Farnborough 3371. Closed Sat.

5WW—114 FOR FURTHER DETAILS.

HARVERSON SURPLUS CO., LTD.

For address see opposite page ➡

OUR LATEST BULK PURCHASE!



BRAND NEW A.C. MAINS 5-VALVE SUPERHET RADIO RECEIVERS

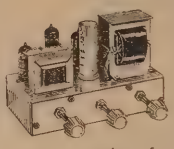
Housed in beautifully styled cabinets offering terrific performance and very high quality reproduction. Built-in ferrite rod aerial for reception of all your favourite programmes. Fully guaranteed.

MODEL 55 (as illus.). Covers Medium, Long and Short waves. Size 8¼in. w. x 3¾in. d. x 4½in. h. **PRICE ONLY £7.17.6** P. & P. 5/6

MODEL 36. Similar circuitry to above but covers Medium wave only. Size 7½in. w. x 3¾in. d. x 4½in. h. **PRICE ONLY £4.14.6** P. & P. 5/6

(Either of the above can be easily adapted for use as AM feeder unit)

3-VALVE AUDIO AMPLIFIER MODEL HA34



Designed for Hi-Fi reproduction of records A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½in. w. x 4in. d. x 4¾in. h. Incorporates ECC83, EL84, EZ80, valves. Heavy duty double wound mains transformer and output transformer matched for 3 ohm speaker, separate Bass, Treble and volume controls. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls.

The HA34 has been specially designed for us and our quantity order enables us to offer them complete with knobs, valves, etc., wired and tested for only **£4.5.0** P. & P. 4/-

TWO VALVE AMPLIFIER similar to above but using ECL82 and EZ80, with tone and volume controls. Output 3 watts. PRICE **75/-**. P. & P. 4/-.

SPECIAL OFFER!

MARCONI QUARTZ CRYSTALS TYPES ZHB

Glass encapsulated, 2 wire lead out. Size 1½in. high x ½in. dia. Following frequencies (Kc/s.) only available:—

13521, 13583, 13646, 13708, 13771, 13833, 13895, 13958, 14021, 14803, 14146, 14208, 14271, 14333, 14396, 14459.

6/- each. P. & P. 1/- per crystal. 3 or more post free.

4-SPEED PLAYER UNIT BARGAINS

All brand new in maker's original packing.

SINGLE PLAYERS

BSR. TU/12... **£3/10/-**. Carr. 3/6.
BSR. GU7 with unit mounted pickup arm ..... **£4/18/8**. Carr. 4/-.

AUTO. CHANGERS

BSR. UA14 ..... **£6/2/6**
Latest B.S.R., UA16 ..... **£7/2/6**

LATEST GARRARD AUTO-SLIM with heavy duty 4-pole motor. FEW ONLY **£7/7/-**. (Standard Auto-Slim **£6/17/6**.) Carr. 5/- on each.

SPECIAL TRANSISTOR BARGAINS ALL BRAND NEW

GET 15 (Matched Pair) **15/-**

OC71 ... 5/- PXA101 ... 6/6
OC72 ... 6/- XA103 ... 6/6
OC76 ... 6/- V15/10p ... 12/6

Set of Mullard 6 transistors, OC44 2—OC45, OC81D matched pair, OC81 **25/-**.

EDISWAN MAZDA

R.F.1 Pack: 1—PXA102 Mixer; 2—PXA101 I.F. Amp.; Equiv. OC44 and OC45) **10/6**
R.F.2 Pack: 2-PXA101 I.F., 1-PXA102 Osc.; 1-PXA102 Mixer **12/6**
L.F.6 Pack: Consisting of PXB113 Driver, Matched pair PXC171, mounted complete with heat sinks (Equiv. OC81D and OC81)... **12/6**

ALL TRANSISTORS POST FREE.

CARTRIDGE BARGAINS!

B.S.R. TC8S High output compatible STEREO CARTRIDGE. Brand new. Complete with Stereo/LP/78 sapphire stylii and universal mounting bracket. Original list price **44/11**. Our price **22/6**. P. & P. 1/-.

COLLARO HI-FI STEREO CERAMIC t/o CARTRIDGE Type "C" Complete with universal bracket and stylii for stereo, L.P. and 78. Original list price 59/8. Our price **25/-**, P. & P. 1/-

ACOS GP65/1 T/O MONO CRYSTAL CARTRIDGE. Complete with sapphire stylii and mounting bracket. Limited number only at **12/6**. P. & P. 1/-.

MARTIN RECORDAKITS

Tape Amplifier for B.S.R. Deck. **£8/8/-**. P. & P. 3/6.

Cabinet with 7 x 4in. speaker for above, **£4/4/-**. - Carr. and Ins. 5/-.

Tape Amplifier for Collaro Studio Deck, **£11/11/-**. P. & P. 3/6.

Cabinets with 9 x 5in. speaker for above **£5/5/-**. Carr. and Ins. 5/-.

Tape Pre-Amplifier for Collaro Studio Deck, complete with power supplies, **£8/8/-**. P. & P. 3/6. Full easy-to-follow instructions supplied.

Send S.A.E. for leaflet.

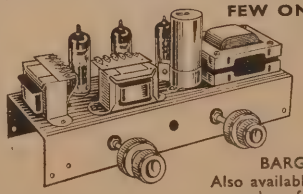
Full range of Microphones and Tape always in stock.

TAPE DECKS

COLLARO STUDIO DECK **£10/10/-** plus 5/6 carr. and ins.

B.S.R. MONARDECK (Single speed) 3¾in. per sec., simple control uses 5¼in. spools, **£6/15/0** plus 5/6 carr. and ins. (Tapes extra on both).

FEW ONLY!



STEREO AMPLIFIER

Incorporating 2 ECL82s and 1 EZ80, heavy duty double wound mains transformer. Output 4 watts per channel. Full tone and volume controls Absolutely complete.

BARGAIN PRICE **89/6** P. & P. 5/-.

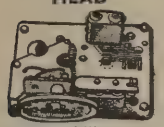
Also available complete with two 8in. x 5in. speakers for only **£5/10/6**. P. & P. 6/6.

5WW—115 FOR FURTHER DETAILS.

SPECIAL PURCHASE! TURRET TUNERS by famous maker

Brand new and unused. Complete with PCC84 and PCF80 valves, 34-38 Mc/s I.F. Biscuits for Channels 1 to 5 and 8 and 9. Circuit diagram supplied.
ONLY **25/-** each. P.P. 2/6.

F.M. TUNER HEAD

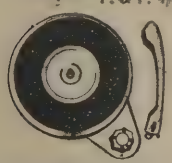


A permeability tuned tuner head by a famous maker supplied without valve (ECC85) and drum and spindle. **18/6**, plus 1/9. P. & P. Valve 8/6 extra. Drum and spindle 3/6 extra.

GÖRLER F.M. TUNER HEADS

10.7 Mc/s I.F. **15/-**, plus 1/9 P. & P. (ECC85 valve, 8/6 extra).

E.M.I. 4-speed Player and P.U. FURTHER HUGE PURCHASE enables us to offer these at 67/6 P. & P. 4/6.



Heavy 8¾in. metal turntable. Low flutter performance 200/250v. shaded motor with tap at 45 v. for amplifier valve fflament if required Turnover LP/78 head.

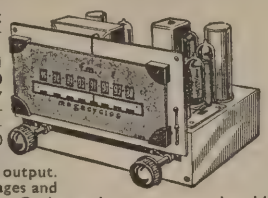
RECORD PLAYER AMPLIFIER

2 valve (EZ80, ECL82), A.C. mains, 3 watts output, ready built tested and complete with valves and output transformer. Size 7in. w. x 2½in. d. x 5½in. h. **55/-**. P. & P. 3/-. Suitable speakers: 6½in. **15/-**. P. & P. 1/6. 10 x 6in. **26/-**. P. & P. 1/6.

SPEAKER & CABINET FABRICS

Oatmeal or Red and Gold Vynair for speaker and cabinet covering, also Red Rexine for cabinet covering only. All 54in. wide and usually sold at 35/- yard.
OUR PRICE **13/6** per yard length. plus P. & P. 1/9 per yard. (Minimum order 1 yard) Send S.A.E. for samples.

HARVERSON'S F.M. TUNER Mk. I



● F.M. tuning head by famous maker. ● Guaranteed non-drift. ● Permeability tuning. ● Frequency coverage 88 - 100 Mc/s. ● OA81 balanced diode output. ● Two I.F. stages and discriminator. ● Attractive maroon and gold dial (7 x 3in. glass). ● Self powered, using a good quality mains transformer and valve rectifier. ● Valves used ECC85, two EF80s, and EZ80 (rectifier). ● Fully drilled chassis. ● Size of completed tuner 8 x 6 x 5½in. ● All parts sold separately. Set of parts if purchased at one time **£5/19/6**, plus 8/6 P.P. and ins. Circuit diagram and instructions 1/6 post free. **Mark II Version** as above but complete with magic eye, front panel and brackets, **£6/12/6**. P. & P. 8/6.
Mark III Version as Mark I but with output stage (ECL82) and tone control. **£7/7/-**. P. & P. 8/6.
Handsome Metal Cabinets. Choice of Grey, Black or Green. To fit Mark I, **25/-**. P. & P. 2/6. To fit Mark II, **17/6**. P. & P. 2/6.

6 TRANSISTOR AND DIODE SUPERHET

A first-class 2 wavebands transistor superhet. ● Printed circuit panel (size 8⅛ x 2¾in.) ● 3 pre-aligned I.F. transformers. ● High-gain Ferrite rod aerial. ● All first-grade transistors. ● Car aerial winding. ● Push-pull output. ● All parts supplied with simple instructions.
All parts sold separately. Set of parts if purchased at one time.
ONLY **£4.5.0** P. & P. 2/6

35 OHM SPEAKERS

Suitable for use with above. 2in. Goodmans. Ideal replacement for most pocket portables **8/6**; 2½in. **10/6**; 3½in. **12/6**; 5in. **17/6**; 7 x 4in. **21/-**. P. & P. 1/6 per speaker.

Portable CABINET

Size approx. 9½ x 6½ x 3½in. Suitable for above using 3½in. speaker, **25/-**. P. & P. 2/-.

COIL AND TRANSFORMER SET FOR TRANSISTOR SUPERHET

3 I.F. transformers, one oscillator coil, one driver transformer and wound Ferrite aerial (med., long and aerial coupling), **28/6** complete, post 1/-. 6 transistor printed circuit board to match, **8/6**, post 9d. Circuit diagram **1/6** extra.

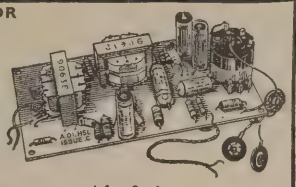
QUALITY RECORD PLAYER AMPLIFIER

A top-quality record player amplifier. This amplifier (which is used in a 29 gn. record player) employs ECC83, EL84, EZ80 valves. Bass, treble and volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7" w. x 2½" d. x 5¼" h.
PRICE 69/6. P. & P. 3/6
DITTO. Mounted on board with output transformer and 6in. speaker.
Complete at **89/6**. P. & P. 4/6.

QUALITY PORTABLE RECORD PLAYER CABINET

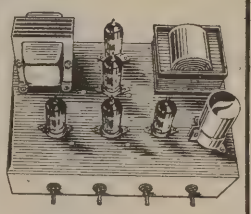
Uncut motor board. Will take above amplifier and B.S.R. or GARRARD Autochanger or Single Record Player Unit. Size 18 x 14 x 8½in.
PRICE £3/9/6. Carr. 5/-.

HIGH GAIN 4-TRANSISTOR PRINTED CIRCUIT AMPLIFIER KIT Type TA1



● Peak output in excess of 1½ watts. ● All standard British components. ● Built on printed circuit panel, size 6 x 3in. ● Generous size Driver and Output Transformers. ● Output transformer tapped for 3 ohm and 15 ohm speakers. ● Transistors (GET 114 or SI Mullard OC81D and matched pair of OC81 o/p). ● 9 volt operation. ● Everything supplied, wire, battery clips, solder, etc. ● Comprehensive easy to follow instructions and circuit diagram 1/6 (Free with Kit). All parts sold separately.
SPECIAL PRICE 45/- P. & P. 2/6
Also ready built and tested, **52/6**. P. & P. 2/6. A pair of TA1's are ideal for stereo.

10/14 WATT HI-FI AMPLIFIER KIT



A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3-15Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 1/6. (Free with parts)
All parts sold separately. ONLY **£6/19/6.** P. & P. 6/6.
Also available ready built and tested complete with input jack plugs, **£8/15/-**. P. & P. 6/6.

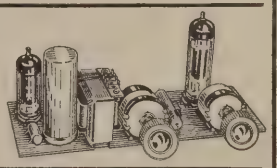
BRAND NEW 3 OHM LOUDSPEAKERS

2½in. **12/6**; 5in. **12/6**; 6½in. **15/-**; 8in. **21/-**; 10in. **25/-**; 12in. **27/6**
E.M.I. 2½in. tweeter **10/6**
10in. x 6in. **26/-**
also 15 ohm 12 inch, **30/-**
Rola Celestion approx. 9in. x 6in. middle register speaker **10/6**
P & P. up to 6in. **1/6**; over 6in. **2/6** per speaker.

AMPLIFIER CARRYING CASES BRAND NEW

Strongly made wooden construction, tough vynide covered, complete with carrying handle. Overall size 13¾in. wide x 9in. deep x 8in. high with sloping front panel. Weight only 4½ lbs. Ideal for our 10/14 watt amplifier and many others.
BARGAIN PRICE **28/6** P. & P. 4/-.

AMPLIFIER ON PRINTED CIRCUIT BOARD



Two valve. UY85, UL84 O.P. trans., use with 80 volt tap off motor. Only **39/6**. P. & P. 2/6.
Dropper res. for filaments if required. **2/6**.

SUPERIOR CABINET. To take 8 x 5in. speaker, with motor board, will accommodate BSR UA14 or UA16. **£3/9/6.** Carr. 5/6. Speaker **10/6** extra. P. & P. 1/6 extra. **LARGE CABINET.** Similar to above with 3 ohm speaker, **£3/9/6.** Carr. 5/-.

BARGAIN CORNER ! !

ACOS CRYSTAL MIKES. High imp. For desk or hand use. High sensitivity, **18/6**. P. & P. 1/6.
TSL CRYSTAL STICK MIKE. Listed at 45/-. Our price **18/6**. P. & P. 1/6.
CARBON MIKE INSERTS. Brand new, 2½in. dia., **3/6** P. & P. 9d.
STANDARD COLVERN 50K W/W Pre-set Pots. 2 for **4/-**. P. & P. 1/-.
STANDARD 1¼in. FUSE HOLDERS. Laminated Twin. 2 for **1/6**. P. & P. 9d. Laminated Single, 2 for 1/-. P. & P. 6d. Belling-Lee Panel mounting, single, 2/- each. P. & P. 6d.
TRANSISTOR DRIVER and O/P TRANSFORMERS. (Tapped 3 ohms and 15 ohms output), plus 4 suitable Transistors giving approx. 1 watt output, **30/-**. P. & P. 2/-.
PRECISION MADE .0005 2-GANG TUNING CONDENSERS. Size 2½ x 2⅜ x 1¾in. **4/-** each. P. & P. 1/6.
5,000 MFD. 12V. WKG. CONDENSERS. Size 3 x 1in. diam. **3/-** each. P. & P. 6d. each.

MAINS TRANSFORMER
Drop thru' type. Tapped primary 110v., 200v., 220v., 240v., 320-0-320v. at 80mA and 6.3v. at 3 amps. Generous core. Stack size 3⅜ x 2¾ x 1⅝in. Weight 4lbs. ONLY **15/-**. P. & P. 3/6.

8in. x 2½in. 3 ohm SLOT SPEAKERS. Specially designed to handle large output. Ideal for high quality reproduction where speaker space is limited. Special purchase, regret no further technical details available but an absolute snip at **8/-** each. P. & P. 1/6 per speaker.

FEW ONLY, 6in. x 4in. 3 ohm Speakers similar to above. Only **9/-**. P. & P. 1/- per speaker.

8in. x 5in. 3 ohm SPEAKERS BY WELL-KNOWN MAKER. Unrepeatable at only **10/6** each. P. & P. 1/6 per speaker. A pair of these are ideal for Stereo.

◀ LOOK OPPOSITE FOR MORE BARGAINS

HARVERSON SURPLUS CO. LTD.

170 HIGH ST. MERTON, S.W.19. CHErrywood 3985/6

Open all day Saturday *Early closing Wed., 1 p.m.*

A few minutes from South Wimbledon Tube Station. *(Please write clearly)*

PLEASE NOTE: P. & P. CHARGES QUOTED APPLY TO U.K. ONLY. P. & P. ON OVERSEAS ORDERS CHARGED EXTRA. (Please enclose stamped addressed envelope with all enquiries).

Have a "sound initiation" at the **1964**

INTERNATIONAL AUDIO FESTIVAL & FAIR

Hear for the first time!

. . . the newest and best sound equipment. Compare the finest loud speakers, amplifiers, tape recorders, pick-ups, discs, tapes and accessories from all over the world. There is as much for the newcomer to the world of quality sound as for the expert.

Anyone who takes pleasure in using and listening to Hi-Fi should not miss this year's AUDIO FAIR.

APRIL

Thurs. 2. 4pm.—9pm.
Fri. 3. 11am.—9pm.
Sat. 4. 11am.—9pm.
Sun. 5. 11am.—8pm.

✱ **TO OBTAIN COMPLIMENTARY TICKETS**
Just ask at your nearest Audio, Radio, Music or Record Shop or write direct (enclosing a stamped, addressed envelope) to:
Audio House, 42 Manchester Street, London, W.1.

HOTEL RUSSELL
RUSSELL SQ, LONDON W.C.1.

5WW—117 FOR FURTHER DETAILS.

Basic Electricity

This book is the first of three volumes which although written primarily to assist airmen under training, is well adapted for civilian needs as the basic theory and principles of electricity and radio (including radar) are of universal application. The treatment is non-mathematical and requires only a knowledge of the basic rules of arithmetic. No previous knowledge of electricity or radio is assumed and great emphasis is placed on the visual approach through copious and largely self-explanatory illustrations which form an integral part of the treatment. It should prove of particular value to craftsmen and craft apprentices and also to the interested layman who is looking for an easily understood introduction to the elements of this subject.

15s. (by post 16s. 5d.)

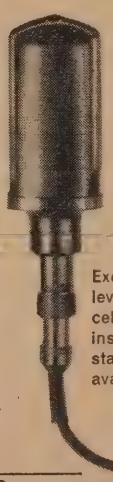
FREE lists of titles (state subject/s) are available from Her Majesty's Stationery Office, P6A (WW), Atlantic House, Holborn Viaduct, London, E.C.1.

HMSO

Government publications can be purchased by calling at, or by post from, the Government Bookshops in London, Edinburgh, Manchester, Birmingham, Cardiff, Bristol and Belfast, or through any bookseller.

5 W W—139 FOR FURTHER DETAILS.

The Grampian Ribbon Microphone



Exceptionally wide frequency response—virtually level from 40 c/s to 15 Kc/s—combined with excellent transient response, makes this the ideal instrument for the studio and wherever a high standard of fidelity is essential. Two models are available, each in three impedance sensitivities.

Model GR. 1, having a semi-cardioid response, gives approximately 10 db suppression to high frequencies at the rear face. It is ideal for overcoming problems of feed-back between microphone and speakers.

Model GR. 2, having a bi-directional "figure of eight" sensitivity pattern, discriminates against unwanted side noise both in the vertical and horizontal planes.

Supplied in attractive, padded instrument case, complete with 18 ft. screened lead, swivel holder and connector. **£11.10.0.**

Grampian

30 years' experience in the manufacture of high-quality microphones

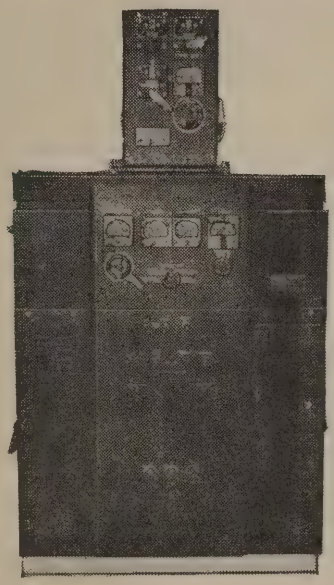
A full range of accessories is available. Please send for illustrated leaflet.
Enquire too for details of the famous Grampian DP4 range of Moving Coil Microphones

GRAMPIAN REPRODUCERS LTD
Hanworth Trading Estate, Feltham, Middlesex. FELtham 2657

5WW—140 FOR FURTHER DETAILS.

EXPORT ONLY

FAMOUS HALLICRAFTER TRANSMITTERS TYPE BC-610-E



Frequency range 2 mc.—18 mc. Three pre-tuned channels selected by switch. Master Oscillator or crystal operation.

450 w. power output on key. 350 w. on telephone. 120 v. A.C. 50/60 cycles supply but special auto-transformer 120/220 v. for 220 v. operation made by Hallicrafter can be supplied additionally.

Tube complement: oscillator 6V6 (1); doubler or buffer 6L6 (1); intermediate amplifier 807 (2); Power amplifier 250TH (1); HV rectifier 866A (2); voltage regulator VT139 (3); audio drive 2A3 (2); modulator 100TH (2); rectifier 5Z3 (2).

Complete with Speech Amplifier BC-614-E; Aerial Tuning Unit BC-939-B; full range of Tank Coils and Exciter Tuning Units; Microphone T-50; Key and Connecting Cables IN BRAND NEW CONDITION. IMMEDIATE DELIVERY.

P.C.A. RADIO

Offices and Works **BEAVOR LANE, HAMMERSMITH, LONDON, W.6** *Telephone: RIV 8006/7*

WIRELESS SET No. 62

(Export only)

TROPICALISED
SENDER/RECEIVER
for AM/RT & C.W.

Considerably lighter and easier to operate than Wireless set No. 22.

Frequency range 1.6 mc/s. to 10 mc/s. in two overlapping ranges. M.O. or crystal control. 2 flick frequencies. Netting by Zero Beat Method.

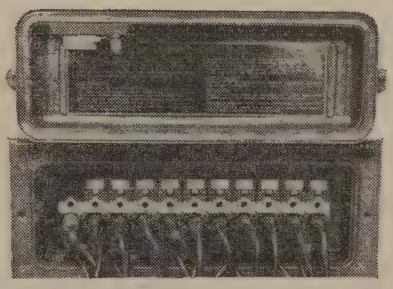
Single tuning control (Send and Receive frequencies are automatically the same). Internal P.S.U. for 12 v. D.C.

Overall measurements
20¼in. × 10½in. × 12⅜in.
Weight 30 lbs.

SWITCHBOARD MAGNETO 10 LINES

(WD)

YA
6733



Designed for use under extreme tropical conditions. Accommodates 10 lines and any type of magneto telephone can be used as extension instruments.

Alarm buzzer. Lightning protectors fitted to each line wire. All cords rubber covered.

Dimensions 14¾in. ×
9¾in. × 5¾in.
Weight 23 lbs.

5WW—118 FOR FURTHER DETAILS.

PROOPS Walk-around Store
and MAIL ORDER SERVICE

52 Tottenham Court Road, London, W.1. ● *Open 9-6, including Sats., Thurs. 9-1* ● **LANgham 0141**

DRY REED SWITCHES

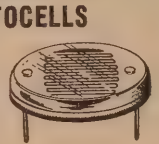
Basically a pair of gold diffused reed contacts hermetically sealed in a glass tube filled with inert gas. Contacts can be actuated by permanent or electromagnets and so form ideal devices for a wonderful range of inexpensive devices such as burglar alarms, limit switches, position indicators, r.p.m. counters, night light controls, door bell switching, level controls, etc., etc. Reed switches have tremendous reliability factors and a working life of about 100 times that of micro-switches, and the uses to which they can be put is limited only by imagination. **Each switch is supplied complete with specification, instructions and ideas information.** **7/-** **each,** *post free.*
Suitable magnets 1/- *extra.*

BURGLAR ALARM KITS £4.10.0

Additional entry points 7/6 each.

All the components to make a foolproof burglar alarm system that can be applied to doors and windows to give instant and continuous warning on opening or even if wiring is cut. Based on professional types using a reed switch and magnet system which is simple to install and operate and undetectable when in place. Kit is supplied to safeguard up to 4 entries, but an unlimited number of entries can be safeguarded for only 7/6d per entry extra. **Complete kit is supplied with full instructions for installation and operation.**

CADMIUM SULPHIDE PHOTOCELLS


TYPE 1

TYPE 2

New, inexpensive photo-conductive cells which act as light-sensitive resistors that increase conductivity with increased light. These are 1,000 times more sensitive than selenium cells, with greater reliability, and can easily be built into a wide range of simple circuits. Typical uses include automatic light controls for home and car, flashing barricade or breakdown lights, exposure meters, brightness controls, relay operation, and many other devices. Requires only simple low power source from battery or mains transformer. Two types available:
TYPE 1.—Max. voltage 200 v. Output 0.5 W. Sens. range 400-800 mu. **10/-** *post free.*
TYPE 2.—Max. voltage 150 v. Output 0.15 W. Both types have a resistance range of 5 megohms at zero to 500 ohms at 1000 lux. Sensitive range is 400-800 mu. Supplied with specification, instructions and typical circuits. **8/6** *post free.*

DIRECT READ-OUT TUBES

XN3 "Numicator" read-out indicators scaled 0-9 and for operation from 180-300 volts D.C. Unit is contained in cylindrical glass envelope size ¾in. diam. × 1½in. high with wire-ended connections. Figure height ½in. Can be used in single circuits to give numerical indication or to form basis for electronic counters with speeds up to 5 kc/s. New current production units complete with specification, performance data and typical circuits. **£1.10.0** **each.**
Set of cold cathode tubes to make one counting stage of 150 c/s counter, **10/6 extra.**
Cold cathode tubes for high speed counters can also be supplied. Send for details.

FILAMENT TRANSFORMERS

High quality drop-through type. Size: 3 × 2½ × 3½in. deep. Input: 200/250 volts A.C., 50 cycles. Output: 6.3 volts centre tapped at 4 amps. New and guaranteed. Tremendous bargain offer, only **5/-** *Post and packing* 2/-.

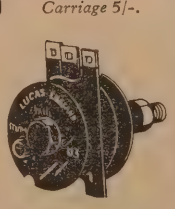
ELECTRO/MECHANICAL COUNTERS 10/-

Post & Pkg. 1/6.

Ultra modern, miniature style, precision made units reading 0-9999. Fitted with 300 ohm coil. Size overall only 3¾in. long × ¾in. square. **In excellent guaranteed condition.**

30 VOLT POWER PACK £4.10.0

Carriage 5/-.



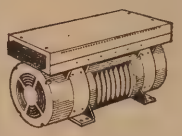
For charging 24 volt battery systems and operating the hundreds of surplus items that require a 24-30 volts D.C. supply. **Specially manufactured transformer is suitable for mains inputs of 200/240 volts, output: 31 and 17 volts at 6 amps. Rectifier is latest diffused silicon bridge type, rated 5 amps. output at 50 p.i.v.** Dimensions: Transformer 4⅛ × 3¾ × 4in. (universal mounting). Rectifier 1½in. diam. × 2in. long, including securing bolt. Both items complete with instructions.

TS 110/AP ECHO BOX £3.10

Carr. 5/-.

Hand-tuned resonant cavity accurate to within 10 mc/s. Relative power and resonance indicated on microammeter. Covers frequency range in excess of 3,140-3,360 mc/s. **Brand new.**

400 C/S MOTOR GENERATOR



Ultra modern equipment made for Airborne Radar Supply Services by Bendix and complete with built-in frequency and voltage control regulation. Input 27.5 v. D.C., 180 A, Output 115 v. 1 phase, 400 c/s at 2,500 vA. Power Factor 0.9.
Size overall 15⅝in. × 7in. × 10⅝in. high. **In guaranteed unused condition** **£30** *Carr. paid*

CONTROL TRANSFORMER

TYPE 810226

Made by Hughes Aircraft Corp. Stator 11.8 v. Rotor 23.2 v. Mounting flange diam. 1in. Length 2⅛in. Shaft length ⅜in., diam. 0.12in. Complete with flying leads.
50/- *Post free.*

SYNCHRO RESOLVER

TYPE R235-1-A

Made by Kearfott, U.S.A. Rotor 2-phase, 26 volts, 400 C/S, Stator 11.8 volts, 2-phase 400 C/S. Mounting flange 1in. diam. length 2in. Drive shaft diam. 0.12in.
50/- *Post free.*

CONTROL MOTOR TYPE R110-2B-B

Made by Kearfott, U.S.A. 2-phase, 400 c/s input which can be 115 volts to each phase, or 115 volts to ph-1. and 57.5 volts to ph-2. Length overall 2⅛in. Mounting flange diam. 1⅜in. Shaft diam. 0.175in.
50/- *Post free.*

EXTRACTOR FANS 27/6

Post and packing 2/6.

Brand new, 230/250 volts A.C. mains operated extractor fans, complete except for external shrouding which can be readily made up from simple sheet metal wrapping to suit any particular installation. Continuously rated, smooth, silent-running induction motor; balanced 3-bladed 6in. fan. Size 7⅛in. diam. 4in. deep.

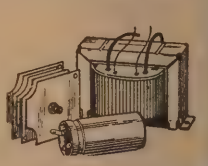
ELECTRONIC TACHOMETER £4.10.0

Carriage 3/6.

Specially made for Proops to a unique design giving greater accuracy than ever before! Uses a brand new transistor circuit operating on induction principles that does not require connection to contact breaker or interfere in any way with the engine ignition system. Can be fitted in minutes without special skill, and is supplied with a universal mounting bracket that ensures ready installation to any car where dashboard space is not available. Transistor unit utilizes printed circuit board technique and top grade components, and is entirely contained within a magnificent aircraft quality instrument with 3-inch circular dial and huge 270 deg. scale that gives really accurate, instant check readings to within 1% of engine speed up to 8,000 r.p.m. Provides a first class, dependable instrument that pays for itself quickly in essential tuning facility, economical motoring, precise gear changing, and that extra feature that earns its place in any car. **Present supplies are for 4-cylinder, 4-stroke, 12v. positive earth systems only. Complete with mounting bracket and fitting instructions.**

1 Amp. MODEL CONTROL POWER PACK 18/6

Post and packing 2/6.



A complete kit—mains transformer, rectifier, and smoothing condensers—all the components to make a splendid 12 volts, 1 amp. power pack for model control, charging, etc. Supplied with full wiring instructions.

5WW—119 **FOR FURTHER DETAILS.**

magnetic recording tape

Gee

LOWEST EVER PRICES

FIRST QUALITY FACTORY FRESH TAPE!

5in.	Std.	600ft.	Mylar	8/6
7in.	Std.	1,200ft.	Mylar	12/6
5in.	L.P.	900ft.	Acetate	10/-
5in.	L.P.	900ft.	Mylar	12/6
5¾in.	L.P.	1,200ft.	Acetate	12/6
5¾in.	L.P.	1,200ft.	Mylar	15/-
7in.	L.P.	1,800ft.	Acetate	15/-
7in.	L.P.	1,800ft.	Mylar	20/-
4in.	D.P.	600ft.	Acetate	9/-
5in.	D.P.	1,200ft.	Mylar	15/-
5¾in.	D.P.	1,800ft.	Mylar	22/6
7in.	D.P.	2,400ft.	Mylar	25/-

"GEE'S" SUPER QUALITY MESSAGE TAPES. 3in. Std. 150 ft. **3/9,** 3in. L.P. 140ft. **5/-;** 3in. D.P. 400ft. **10/-.** On brightly coloured spools in neat plastic cassettes. Ideal for gifts or messages.

COLLARO "STUDIO" TAPE TRANSCRIPTORS. Brand new in original cartons. 3 speeds, 1⅞, 3¾, 7½ i.p.s. 3 motors, digital counter, etc. Complete with 7in. spools, instructions and fixings. A.C. 200/230 v. operation. **SPECIAL PRICE 10 GNS.** Carr. paid.

AMERICAN "SHAMROCK" TAPE
EXCLUSIVE TO GEE'S
7in. L.P. 1,800ft. 15/6
Professional quality

THE "INSTANT" BULK TAPE ERASER A complete reel of magnetic tape can be effectively erased of all traces of recorded matter within a few seconds leaving tape as new. Operates on A.C. 200/250 v. Today's price 35/-. FEW ONLY AT **30/-.** P. & P. 2/6.

"GEE'S" ACCESSORY KIT 1 "BIB" Splicer, 1 Splicing Tape, 3 Leader Tapes (3 colours), 10 Retaining Clips, Packed in plastic container. PRICE **32/6.** While stocks last. **SPARE SPOOLS.** 2½in. **1/6;** 3in. **1/-;** 4in., 5in., 5½in., **2/-** each, 7in. **2/6;** 8½in. **5/-.**

Where not stated, please add P. & P. 2/- per order. (Orders over £3 post free.) Many other types available including "SCOTCH," "EMI," "BASF," "Synchrotape," etc. Send S.A.E. for our huge money-saving literature on Tapes and Accessories. **SPECIAL DISCOUNT FOR TAPE QUANTITIES.**

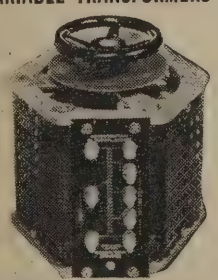
GARRARD RECORD PLAYER BARGAINS

SRP10 Single Player	£4	17	6. Carr. 4/-
Autoslim De Luxe AT6 Mono (with Stereo cartridge £1 extra.)	£10	9	6. Carr. 4/-
Autoslim Mono Plug in head	£6	19	6. Carr. 4/-
4HF Mono	£16	5	0. Carr. 4/-

MICROPHONE FLOOR STAND (Telescopic). HEAVY 9in. dome, chromium base, chromium stand with screw top. Extends to approx. 6ft. **55/-.** Carr. 5/-.

15 WATT TRANSISTOR POWER AMPLIFIER A new transistor Audio Frequency Amplifier of new modern design incorporating a number of additional practical features. Operates on 12 volts. Power output 15 watts. Output impedance 25, 15, or 3.75 ohms. Inputs for mike and gram. Frequency response 100 c/s. to 10 kc/s. Incorporates on/off switch, volume control, tone control, pilot lamp. Complete in pale green hammer finish metal case, size 6 × 3½ × 5¾in. Weight 4½ lbs. Made in England. Brand new and fully guaranteed. All parts replaceable. **ONLY £21.**

'POWERSTAT' VARIABLE TRANSFORMERS

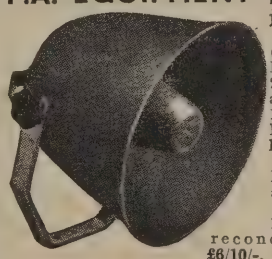


Input 230 volts. 50/60 cycles. Output 0-260 volts at 9 amps. Fully shrouded. For bench or panel mounting. A robust job of outstanding quality and performance. Brand new and guaranteed. **£15.** Carr. 7/6. Made in U.S.A.

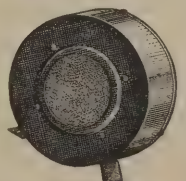
AUTO TRANSFORMERS. Step up, step down, 110/115, 220/230. v. Fully shrouded terminal block connectors. 150 w. **32/6;** 300 w. **47/6;** 500 w. **67/6;** 750 w. **77/6;** 1,000 w. **90/-;** 1,750 w. **175/-.** Carriage 5/- on each type.

RCA PLATE TRANSFORMERS 190 to 250 v. primary 50-60 cycles. Secondary 1,500-0-1,500 v. or 2,000-0-2,000 v. at 500 milliamps. Brand new and boxed **£6/10/-.** Carriage extra.

P.A. EQUIPMENT



RE-ENTRANT LOUD HAILERS (Ex-Govt.) Heavy duty 20 watts., all-metal, 15 ohms. Dia. 15in., length 15in., (approx.). Brand new and boxed. **£9.** Carr. 10/-. Ditto reconditioned, **£6/10/-.** Carr. 10/-.

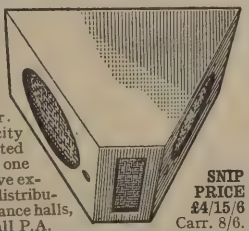


6 inch P.M. HEAVY DUTY SPEAKERS. Complete with line trans., in all steel blue-grey double grilled cabinet, **30/-.** P. & P. 3/-. Ditto, with 10in. P.M. speaker **39/6.** Carr. 6/-.

TRUVOX TANNOY LOUD HAILERS. With 180 ohm line transformer and condenser. Impedance 7½ ohms, handling capacity 8 watts. Complete in slope-front wooden case, **30/-.** Carr. 5/-.

W.B. STENTORIAN 12in. heavy duty 15 ohm. Speaker. Handling capacity 15-20 w. Listed £10/5/-. **OUR PRICE £4/15/-.** P. & P. 5/-.

W.B. Stentorian Dual Purpose Speaker System



Incorporates 2 8" 3 ohm speakers and 100 volt line transformer. Handling capacity 10 watts. Mounted back to back in one cabinet they give excellent sound distribution. Ideal for dance halls, factories, and all P.A. systems. **LIMITED QUANTITY ONLY.**

SNIP PRICE £4/15/6 Carr. 8/6.

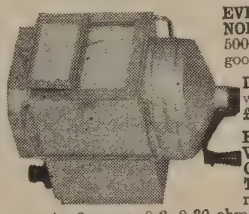
100,000 O.P.V. MULTI-TESTER MODEL 370-N

£14.14.0

Incorporates 9.5 μA. basic meter, scale size 4×2½in. Ranges D.C. volts, 8 ranges 100 mV. to 5 kv. D.C. amps., 7 ranges, 10 μA. to 10 A. A.C. volts, 6 ranges 2.5 v. to 1 kv. Ohms 5 ranges 0-50 megohms and 5 ranges 40 ohms to 400 K ohms. Overall size 7×5 ×2½in.

COSSOR 1035 DOUBLE BEAM OSCILLOSCOPE A fine instrument in perfect condition and in good working order, **£40.** Carr. 30/-. Also 1049 at **£45.** Carr. 30/-.

30,000 o.p.v. MULTI-TESTER MODEL 500 Ranges D.C. volts 0-1,000 v. A.C. volts 0-1,000 v. (15,000 o.p.v.). D.C. current 0-05 500 mA., 0-12 v. Resistance 0-60 megs. Decibel +20 to −56 dB. Sizes 3⅛in.×6⅛in.×2¾in. **ONLY £8/17/6.** Both above supplied complete with instruction manual, test leads and batteries.



EVERSHED & VIGNOLES Series II. 500 v. Megger in good cond. **£18/18.**

DITTO. NEW with leather case **£25.**

EVERSHED & VIGNOLES MEGGER CIRCUIT TESTER (low reading ohm meter). 2 ranges 0-3, 0-30 ohm. Complete with leather case and test leads. As new, **£6/6.** Ditto 0-500, 100-5,000 ohms, **£6.**

EVERSHED & VIGNOLES. Wee Megger 500 v., with leather carrying case, good working order **£15.** Also 100 v., as above, **£6/6/-.**

BRIDGE MEGGERS. Evershed and Vignoles Series 2, 500 v. Accurate working order, perfect condition, fully tested. Complete with leather case, **£40.**

AVO MODEL 7. 50 ranges of A.C. D.C. tests. Complete with leads and batteries. Ready for use. Perfect order. **ONLY 10 gns.** Carr. 5/-.

OUTSTANDING BUYS IN QUALITY MULTIMETERS

Model Y.3. 2,000 ohms per volt. Sub-miniature in size and convenient in use. Ranges D.C. volts, 6, 30, 150, 500, A.C. volts, 6, 30, 150, 600. D.C. amps. 150 mA. Ohms, 0-100 K ohms. Size 3⅜×2¼×1⅜in. **PRICE 39/6.** P. & P. 2/-.

Model YP.60. 3,300 ohms per volt. Pocket size unsuitable for general use. Ranges D.C. volts, 6, 12, 60, 300, 1,200. A.C. volts, 6, 12, 60, 300, 1,200. D.C. amps., 300μA, 3 mA. 300 mA. Ohms, 0-30 K ohms, 0-3 M ohms. DB, −20 to +18 dB, 0 to +24 dB. Size, 4⅜×3¼×1⅜in. **PRICE 52/6.** P. & P. 2/-.

All complete with test leads, battery, instructions and fully guaranteed.

G.P.O. STANDARD 19in. HEAVY DUTY EQUIPMENT RACKS

4ft. 6in. Channel Uprights, **£4.** Carr. 15/-.
5ft. 6in. Angle Uprights, **£4/10/-.** Carr. 15/-.
6ft. Channel Upright, **£6.** Carr. 20/-.
7ft. Channel Upright, **£7.** Carr. 20/-.
All with Heavy Duty Base.

WANTED FOR CASH!!

Good quality modern P.A. Equipment, Test Equipment, Hi-Fi Equipment, what have you! Single items or quantities. Offers by return.

GEE BROS. RADIO LTD.
15 LITTLE NEWPORT STREET, LONDON, W.C.2 GER. 6794/1453
Open 9-6 Mon. to Fri. 1 p.m. Sat.
Adjoining Leicester Square Tube.

5WW—120 FOR FURTHER DETAILS.

TEST METERS

30,000 OHMS PER VOLT MODEL 500. Reads voltages up to 1,000 D.C. at 30,000 ohms per volt and A.C. at 16,000 o.p.v.; D.C. current to 12 amps.; Resistance to 60 Mega.; Decibels from −20 to +56; Incorporates internal buzzer for audible warning of direct shorts and blocking condenser for AF output measurements. Size 3 5/16 × 6 5/16 × 2¾in. £8/19/6.

2,000 OHMS PER VOLT MODEL TP-10. Reads A.C. and D.C. volts up to 1,000; D.C. current to 500mA; Resistance to 1 Meg.; Capacitance to 1μF; Decibels from −20 to +36; Output jack for Audio measurements. Size: 3½ × 5 × 1¼in. £3/19/6.

20,000 OHMS PER VOLT MODEL TP-5S. Reads voltages up to 1,000 D.C. at 20,000 ohms per volt and A.C. at 10,000 o.p.v.; D.C. current to 500mA; Resistance to 10 Megs; Capacitance to 0.1μF; Decibels from −20 to +36. Size: 3½ × 5½ × 1¼in. £5/19/6.

LAVOIE UHF WAVEMETER MODEL 105. Coverage 375/725 Mc/s. Complete with correct Calibration Chart. First-class condition. Battery operated and portable. Size 11 × 8 × 7½in. ONLY £3/19/6 (carriage 7/6).

PANEL METERS

25 microamps D.C. 2½in. Proj-circular **59/6.** 50 microamps D.C. 2½in. Flush circular, **59/6.** 100 microamps. D.C. 2½in. Flush circular **39/6.** 200 milliamps. D.C. 2½in. Flush circular, **12/6.** 40 amps. D.C. 2in. Proj. circular, **7/6.** 500 volts A.C. 2½in. Flush circular, **25/-.**

HIGH FREQUENCY A.C. VOLTMETER

A First Grade Moving Iron Instrument with 6in. Mirror Scale, reading up to 150 volts A.C. at 400 and 1,200-2,400 cycles. In substantial Oak case with removable lid, overall size 8½ × 8½ × 5½in. Made for the Air Ministry by Everett Edgcumbe, and in perfect order. Brand New and Unused. ONLY **£5.0.0.** Can also be supplied for 50 cycles, use either 0-150 or 0-300 volts.

DOUBLE BEAM OSCILLOSCOPE TUBES

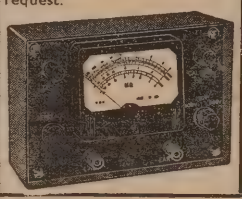
Another purchase of Type CV 1596, equivalent to Cossor 09D as used in Oscilloscopes by Cossor (339 series) and Hartley & Erskine (13 series). Listed £12. Brand new in maker's crates **25/-** (carriage 5/-)

MINIATURE MOTORS.

Ideal for models. Operate on 5-6 v. D.C. Size 1½ × 1 3/16in., plus ¼in. spindle. Brand new 5/-.

TRANSISTORISED INSULATION TESTER

One handed operation, no cranking of generator. 3 testing voltages 100, 250 and 500, to measure up to 500 Megohms. Complete with leather carrying case and test leads. ONLY £17/10/0. Illustrated details on request.



AMERICAN DESK TELEPHONE

complete with handset. Non-dial type, but has internal bell. Ideal for extension or inter-com. BRAND NEW, ONLY 30/-. (Post 4/-.

ACOS 39/1 STICK MIKE

with screened lead and table stand. ONLY **32/6.** (Post 1/6).

CRYSTAL DESK MIKE

with screened lead and built-in stand. ONLY **15/-.** (Post 1/6).

PCR COMMUNICATION RECEIVERS

Manufactured by **Pye and Philips.** One of the Army's most versatile and sensitive sets. RF stage and 2 of IF, using 6 British I.O. type valves. Large 180 degrees illuminated and calibrated dial. Flywheel tuning with locking device. Aerial trimmer. Tone and volume controls. Band switch. Front panel jacks for speaker or phones. In black metal case, size 17" L x 8" H x 10" D. **Model PCR2** covers 6-22 Mc/s, 200-550 metres, and 850-2,000 metres, **£5.19.6. Model PCR3.** As PCR2 but has 2 Short Wave Bands. 2.0-7.0 Mc/s and 7.0-23.0 Mc/s, and Medium Wave Band 190-550 metres. ONLY **£8.8.0.** Both types used but excellent condition. Every receiver aerial tested before despatch. Add 10/6 carr. both models. Designed to operate from bulky EXTERNAL power supply, but any set can be fitted with BRAND NEW COMPONENTS INTERNAL PACK for 200/250 v. A.C. at extra cost of **£2.** *S.A.E. for illustrated leaflet.*

HETERODYNE FREQUENCY METERS TYPE LM14

Frequency range 125-20,000 kc/s in 2 bands. This is the United States Navy Model of the well-known BC.221 Frequency Meter, but has many additional features which increase its usefulness. Voltage stabilisation circuits and Crystal control ensure extreme accuracy and in addition it is fitted with an Internal Modulation switch to allow use as a Signal Generator. Size only 8½in. × 8in. × 8½in. Full information on request.

COSSOR TYPE 1035 DOUBLE BEAM OSCILLOSCOPES. A few only of these modern scopes, overhauled and in perfect order ONLY **£45.** Further details on request.

HARRIS ELECTRONICS (LONDON) LTD.

138 GRAY'S INN ROAD, LONDON, W.C.1 *Telephone TERminus 7937*

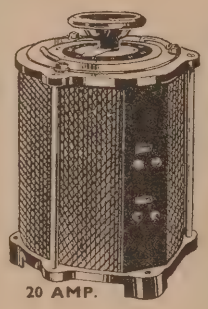
Please include carriage costs on ALL items. Open until 1 p.m. Saturdays.

We are 2 mins. from High Holborn (Chancery Lane Station) and 5 mins. by bus from King's Cross.

5WW—121 FOR FURTHER DETAILS.

VARIABLE VOLTAGE TRANSFORMERS

INPUT 230 v. AC 50/60 ~



20 AMP.

BRAND NEW. Carriage Paid. Buy direct from the importer, keenest prices in the country. All Types and Spares available from stock.

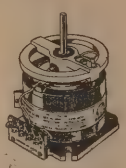
We are pleased to announce further additions to our range:

Type 1	0-260 v. at 1 amp ...	£4	10	0
Type 2	0-260 v. at 2.5 amps	£5	17	6
Type 2A	2.5 amps, Portable ...	£9	17	6
Type 3	0-260 v. at 5 amps ...	£9	0	0
Type 4	0-260 v. at 8 amps ...	£14	10	0
Type 5	0-260 v. at 10 amps...	£16	10	0
Type 6	0-260 v. at 12 amps...	£18	15	0
Type 7	0-260 v. at 20 amps...	£32	10	0

These instruments are fully shrouded

2.5 AMP.

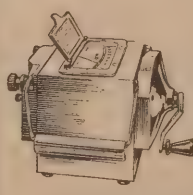
1 AMP. OPEN TYPE



(Type 1A.) Compact, well constructed unit designed for building into equipment. Panel or back mounting, extending shaft. Complete with engraved voltage panel and control knob. Input 230v. A.C. Output variable 0-260v. Ideally suited for Manufacturers of variable voltage equipment.

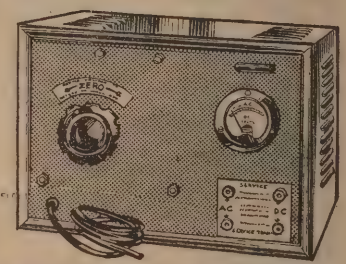
Price: **£4 17 6d** post paid.

INSULATION TESTERS (NEW)



Test to I.E.E. Spec. Rugged metal constructed, suitable for bench or field work, constant speed clutch. Size L. 8in., W. 4in., H. 6in. Weight 6lb. 500 volt, 500 megohms. Price **£22,** carriage paid. 1,000 volts, 1,000 megohms, **£28,** carriage paid.

7 Ampere A.C./D.C. VARIABLE OUTPUT UNIT



Input 230 v. A.C. Output continuously VARIABLE from 0 to 260 volts A.C. OR 0 to 230 volts D.C. at 7 amps. Robustly constructed in metal case, complete with safety fuse, neon indicator and voltmeter. Size 17in. x 12in. x 7in. Weight 36lb. Price £34/10/-. Carriage 20/-.

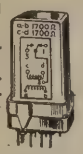
SERVICE TRADING COMPANY →

5WW—122 FOR FURTHER DETAILS.

ULTRA VIOLET BULBS

Easy to use source of UV for dozens of practical and experimental uses.
12 volt 36 watt AC/DC SBC **6/6.** P. & P. 1/-.
12 volt 60 watt AC/DC SBC **8/6.** P. & P. 1/-.
Transformer to suit the above: Input 200–240 A.C. 12 volt 36 watt, **16/6**; P. & P. 2/6. Input 200–240 A.C. 12 volt 60 watt, **22/6.** P. & P. 3/6.
Set of 4 Colours FLUORESCENT PAINT. Red-yellow, green and blue. In ½oz. tins. Ideal for use with the above Ultra Violet Bulbs. **9/6,** plus 1/6 P. & P.

SIEMENS SEALED HIGH SPEED RELAYS.



H96A, 2.2 ohm+2.2 ohm, new, **12/6.**
H96B, 50 ohm+50 ohm, new **12/6**
H96C, 145 ohm+145 ohm, new, **12/6.**
H96D, 500 ohm+500 ohm, new, **12/6.**
H96E, 1700 ohm+1700 ohm, ex-equip., **16/6.**
P. & P. 1/- or each Relay.

CARPENTER'S TYPE 5C9B POLARISED RELAYS. 2 x 9,500 turns at 1,685 ohms. Price **22/6** each. P. & P. 1/-.

Type 5A57 (Z)A 65 ohms coil. Will operate on less than .5 of a volt. **22/6.** P. & P. 1/-.

FOSTER CONSTANT VOLTAGE TRANSFORMER

Automatic or hand operated. Input 250 volt +5 −15%. Output adjustable 200/250 volt. Max. load **80 AMP.** electro magnet control unit as new **£95** ex warehouse.

P.O. RELAYS TYPE 3000

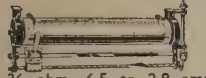
200 ohm, 6 c/o, **12/6.** 1,000 ohm, 6 c/o, **12/6.** 20,000 ohm, 4 c/o, **12/6.** 2,000 ohms coil, 4 make 4 break, **12/6** each. 6,500 ohms, 1 change-over, 1 break, price **12/6.** 10,000 ohms coil, 2 light c/o, 2 heavy duty c/o, price **22/6.** 16,000 ohms, 2 make 2 break, Price **15/-.** P. & P. 1/- each item.

G.E.C. SEALED RELAY TYPE M.1492 24 volt 670 ohm, 4 changeover, ex new equip., **12/6.** P. & P. 1/-. Type M1095, **12/6.** P. & P. 1/-.

EVERSHED AND VIGNOLES BRIDGE MEGGER. 500 v. Constant Pressure Series 2 with decade and varley loop facilities, perfect condition **£40** including leather case and carriage.

NSP2 CV2296 STROBOTRON FLASH TUBE made by Ferranti, brand new, I.O. base. Price **15/-.** P. & P. 1/-.

SLIDER RESISTANCES



Geared drive, new. 1.2 ohm, 14 amp. **27/6** 35 ohm 3 amp. **37/6** 75 ohm, 2 amp. **37/6** 200 ohm, 1.25 amp. **37/6**
36 ohm, 6.5 to 2.8 amp. tapered winding, geared drive (less knob) **45/-.** P. & P. 3/6.

W.W. RHEOSTAT. New. 3.5K, 25 watts. Price **7/6.** P. & P. 1/6. 22 ohm 1.5 amp., complete with knob, **8/6,** plus 1/6 P. & P.

EVERSHED AND VIGNOLES MEGGER CIRCUIT TESTER. (Low reading ohm meter.) 2 ranges, 0–3, 0–30 ohms. Complete with test leads, battery and leather carrying case. **£6/6/-.** Post paid.

ADJUSTABLE THERMOSTAT

Mid-point setting 65°F, range 60 to 75°F, 15 amps. A.C. 230 volt. Price **8/6,** plus P. & P. 1/6.

UNISELECTOR 8 bank 25 way 75 ohm coil full wiper, ex equipment. Individually tested. **45/-,** plus 2/6 P. & P.

HIGH SPEED BLOWER UNIT

200/250 volt A.C. Powerful 2 speed motor, 11,000 and 13,000 R.P.M. **17/6,** plus 2/6 P. & P.

EX P.O. MAGNETIC COUNTER, either 500 ohms for 24 volt operation or 3 ohms for 6 volt D.C. operation. 4 figures to 9,999. Price, either type **8/6.** P. & P. 1/6.

LATEST HIGH SPEED TYPE 100B, 10 IMPULSES PER SECOND. 2,300 ohm coil for 36-48 volt D.C. operation. Price **15/-,** P. & P. 1/6.

CROMPTON PARKINSON BRAND NEW ¼ h.p. MOTORS. 230/250 VOLT A.C. 1,400 R.P.M. Fitted with 2½ x ½in. SPINDLE. **Price £3/15/-.** Carriage 8/6.

6-VOLT 40 A.H. ACCUMULATORS in metal case with leather carrying handle. Brand new, **27/6.** Carriage 8/-.

AUTO TRANSFORMERS. Step up, step down. 110–200–220–240 v. Fully shrouded. New. 300 watt type **£2/6/6** each. P. & P. 2/6. 500 watt type **£3/7/6** each. P. & P. 3/9. 1,000 watt type **£4/10/-** each. P. & P. 6/6.

MINIATURE MOVING COIL DIFFERENTIAL RELAY. Two coils 350 ohms each.

Operating current minimum 140 micro-amp., nominal 400 microamp, maximum 8 milliamp. One pole two way, or centre stable. Two way contact current 100 mA. at 50 v. A.C. or D.C. Size 1½ x ⅝ x ⅝in. Individually tested. Price **22/6** each, 1/- P. & P.

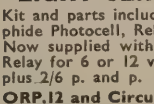
230 V. A.C. RELAY, 10,000 ohm coil, 3 change over, 5 amp. non inductive load, price **18/6,** plus 1/6 P. & P.

230 VOLT A.C. GEARED MOTORS

Type B16G 80 r.p.m. .26lb. inch £1/19/6. P. & P. 2/-.
Type D16G 5 r.p.m. 1.7lb. inch £2/9/6. P. & P. 2/6.
Type D16G 13 r.p.m. 1.45lb. inch £2/12/6. P. & P. 2/6.

230 Volt A.C. 50 c/s 5-figure Veeder-root Counter (not resettable). New. Boxed. **19/6,** plus 2/6 P. & P.

MINIATURE UNISELECTOR SWITCH



3 banks of 11 positions, plus homing bank. 40 ohm coil. 24–36 v. operation. Ex equip. Individually tested. **22/6,** plus 2/6 P. & P.

20-WAY STRIP containing standard Post Office telephone Jack Sockets, overall size 11 x 3½in. x ½in. New. Price **15/-** each. P. & P. 1/6. TAKE IN 8PT.

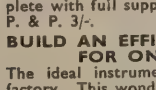
LIGHT SENSITIVE SWITCH

Kit and parts including ORP.12 Cadmium Sulphide Photocell, Relay, Transistor and Circuit. Now supplied with new Siemens High Speed Relay for 6 or 12 volt operation. **Price 25/-,** plus 2/6 p. and p.

ORP.12 and Circuit 10/6, post paid.

MINIATURE LEAD ACID ACCUMULATORS (brand new). 2 v. 1.5 A.H. Size 4 x 1½ x 1in. Wt. approx. ¾lb. **16/6** for 3. P. & P. 1/6.
12 v. 0.75 A.H. Size 4 x 3 x 1½in. Wt. approx. 2 lb. (can be used as double 6 v.). **15/6** each, P. & P. 1/6.

9 R.P.M. GEARED MOTOR. 24 volt D.C. (Will operate from 12 volt.)



Double gear box. Consumption 200 m.A. Size 3½ x 2⅛ x 2in. Weight 15 oz. Small and extremely powerful. Price **32/6** plus P. & P. 3/-. Or complete with full suppression and case **37/6,** plus P. & P. 3/-.

BUILD AN EFFICIENT STROBE UNIT FOR ONLY "37/6"

The ideal instrument for workship, lab. or factory. This wonderful device enables you to "freeze" motion and examine moving parts as if stationary. We supply a simple circuit diagram and all electrical parts including the NSP2 Strobe tube which will enable you to easily and quickly construct a unit for infinite variety of speeds, from 1 flash in several seconds to several thousands per minute. New, modified circuits bring price down to **37/6,** plus 3/- P. & P.

14-DAY CLOCKWORK TIME SWITCHES USED but guaranteed, 2½ amp. **30/-.** P. & P. 2/6. 5 amp. type, **35/6.** P. & P. 2/6.

TRANSISTORS

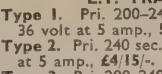
1st grade		Brand new	
OC41	7/-	OC203	14/-
OC45	5/-	Get 104	6/-
OC45 M/pair	9/-	Get 105	10/-
OC71	5/-	Get 573	12/6
OC72	7/-	Get 573 M/pair	25/-
OC72 M/pair	14/-	2N458	20/-
OC73	6/-	2S005	30/-
OC75	7/-	SB345	7/6
OC76	6/-	TK20B	4/-
OC77	9/-	XC141	10/-
OC139	12/-	AC107	14/6
OC140	19/-	AF114	11/-
OC171	10/6	AF115	10/6
OC201	21/-	AF116	10/-
OC202	21/-	AF117	9/6

DIODES

OA91	3/-	IS111	4/-
SX781	4/-	ZS10B	3/-

ZENERS 5%

All ¼ watt 5% at **10/-** each. 4.3 v., 4.7 v., 5.1 v., 5.6 v., 6.8 v., 7.5 v., 8.2 v., 9.1 v., 10 v., 16 v., 22 v.



INSULATED TERMINALS available in black, red, white, yellow, blue and green. New **15/-** per doz. P. & P. 1/-.

L.T. TRANSFORMER

Type 1. Pri. 200–240 sec. tapped 30, 32, 34, 36 volt at 5 amp., **57/6.** P. & P. 4/-.
Type 2. Pri. 240 sec. tapped 30, 40 and 50 volt at 5 amp., **£4/15/-.** P. & P. 5/-.
Type 3. Pri. 200–240 sec. tapped 10, 17 and 18 volt at 10 amp., **57/6.** P. & P. 4/-.
Type 4. Pri. 240 sec. tapped 6 and 12 volt at 20 amp., **72/6.** P. & P. 5/-.

METERS, GUARANTEED PERFECT

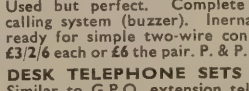
5 amp. D.C. M.I 2½in. fl. rnd.	11/6
10–0–10 amp. D.C. 2in. fl. round	12/6
Voltmeters	
0–300 volt A.C. MI 2½in. fl. rnd. New	22/6
0–300 volt A.C. Rect. M-C type W23 3½in. fl. round new	55/-
400 v. A.C. M.I. 4½in. rnd.	35/-
90-180 v. A.C. M.I. 4½in. fl. iron	25/-
Milliammeters	
0–1 Milliamp Meter. 2½in. fl.	25/-
0–350 mA. T.C. 2in. fl. rnd.	8/6
500 microamp., M.C. 2½in. rnd. fl. scaled 15/600 volt. NEW	16/6

500 MICROAMP SUB-MINIATURE M/C METER

1½in. diameter, flush mounting, single hole fixing. Scaled 0–1 mA. Supplied with Resistor for use as 1 mA. if required. **29/6,** plus 1/- P. & P.
Postage on all meters, **1/-** each.

SANGAMO WESTON DUAL RANGE VOLTMETER. 5 and 100 volt D.C. 3in. scale. F.S.D. 1 mA. Brand new in carrying case with Test prods and leads. **Price 27/6.** P. & P. 3/-.

4 DIAL DECADE RESISTANCE BOX



Range 0-11,110 ohm. X1 Wire Wound, Max. current 300 mA. X10 Wire Wound, Max. current 150 mA. X100, X1,000. High Stability Resistors, rated 1 watt. Accuracy + —1%.
Switches make before break type fitted with low resistance silver plated contacts, polished wood case, new, **price £10/10/-,** plus 6/6 P. & P.

DESK TELEPHONES—TYPE 1

Used but perfect. Complete with two-way calling system (buzzer). Inernal battery. All ready for simple two-wire connection. **Price £3/2/6** each or **£6** the pair. P. & P. 3/6 each phone.

DESK TELEPHONE SETS — TYPE 11. Similar to G.P.O. extension telephones. Each complete with automatic dial, internal bell and long connection cord. Used but in perfect working order. **Price £2/17/6** each. P. & P. 4/-. **P.O. Telephone handsets, 10/6** each. Plus 2/- P. & P.

Postage and Carriage shown above are inland only. For overseas please ask for quotation. We do not issue a catalogue or list.

SERVICE TRADING Co.

PERSONAL CALLERS ONLY: **9 LITTLE NEWPORT STREET, LONDON, W.C.2.** *Tel: GER 0576*
(OFF LEICESTER SQUARE)
ALL MAIL ORDERS. ALSO CALLERS AT:
47-49 HIGH STREET, KINGSTON-ON-THAMES.
Telephone: KINgston 9450

5WW—123 FOR FURTHER DETAILS.

MULTI-RANGE TESTMETERS

Caby MI	£2 14 0
Caby B20	£6 10 0
Eagle EP10K...	£4 12 6
Model 200H ...	£5 5 0
Eagle EP50K...	£9 19 6
Caby A10	£4 17 6
Taylor 127A...	£10 0 0
Eagle TK20A...	£2 9 6
Eagle EP30K ...	£6 19 6

TRANSISTORS

AC107	14/6	OAZ207	7/–	OC72	5/6
AD140	25/–	OC16W	35/–	2OC72	16/–
AF102	27/6	OC19	25/–	OC74	8/–
AF114	11/–	OC26	25/–	OC75	5/6
AF115	10/6	OC35	12/–	OC78	8/–
AF116	10/-	OC42	6/–	OC81	5/6
AF117	9/6	OC44	5/–	OC81M	8/–
AF118	20/–	OC44M	9/3	OC82	10/–
AF124	10/–	OC45	5/–	OC83	4/–
AF125	10/6	OC45M	9/–	OC139	8/–
AF126	10/-	OC70	6/6	OC170	9/6
AF127	9/6	OC71	4/3	OC171	10/6

DIODES

BY100	7/6	OA90	3/–	GEX34	4/–
OC70	3/–	OA91	3/–	GEX35	4/–
OC79	3/–	OA95	3/6	GEX36	10/–
OC81	2/–	OA210	9/6		

SETS OF TRANSISTORS

Set No. 1 comprising OC44, 2 x OC45, OC81 Driver, matched pair OC81, 20/-.
Set. No. 2 comprising OC81 Driver, matched pair OC81, 10/-.

AMERICAN RECORDING TAPE. Standard play 5in. spool, 600ft., 9/6; 5¾in. spool 850ft. 11/9; 7in. spool 1,200ft. 14/9; long play 5in. spool 900ft. 12/6; 5¾in. spool 1,200ft. 15/-; 7in. spool 1,800ft. 19/6.

Radio Tuner, suitable for use with amplifiers and tape recorders, complete with standard Jack plug, covers medium waveband, with instructions, 29/- each.

GRAMOPHONE UNITS

BSR TU12 unit, with Mono TC8H Cartridge, £3/19/6.
BSR GU7 unit, with TC8M or TC8H Cartridge, Mono, £4/15/-.
BSR GU7 unit, with TC8S C'ridge, Stereo, £5/5/-.
Garrard Autoslim, automatic, with GC8 Mono Cartridge, £7/15/-.
Garrard Autoslim, automatic, with EV26 Stereo Cartridge, £8/10/-.
Garrard Autoslim de luxe with GC8 Mono Cartridge, £11/5/-.
Garrard Autoslim de luxe, with EV26 Stereo Cartridge, £12.
BSR Monarch UA14, with TC8 Mono Cartridge, £6/6/-.
BSR Monarch UA14, with TC8S Stereo Cartridge, £7/7/-.
BSR Monarch UA16, with TC8 Mono Cartridge, £6/19/6.
BSR Monarch UA16, with TC8S Stereo Cartridge, £7/19/6.

AMPLIFIERS

Transistor Amplifier 1 watt, 2 input points with sensitivities of 10 mV. and 250 mV., isolated 3-ohm speaker output, 42/-. Transistor amplifier 15 watt, operated from a 12 v. battery, push-pull output. 2 separately controlled input, 15 gns. 3 watt valve amplifier, controls volume, treble, bass with on-off, valves EZ80, ECL86, £4/19/6. Amplifier 12 watt output to suit 3, 7 or 15 ohms speaker, 5 valves, EF86, 12AX7, 2 x EL84, EZ81, 15 gns.

Fully transistorised Intercom./Baby alarm in two compact units each size 4in. x 2½in. x 1in. Internal loudspeakers give ample volume. Complete, ready for immediate use. Works from TP3 battery. Price 69/6.

MICROAMMETERS/MILLIAMMETERS

0-50μA 39/6, 0-500 μA 32/6, 0-1 mA. 27/6, 0-5 mA. 27/6, 0-300 v. 27/6, "S" Meter 35/-.

OUR 1964 56 PAGE CATALOGUE IS NOW AVAILABLE, PLEASE SEND 1/- IN STAMPS FOR YOUR COPY. TRADE CATALOGUE ALSO AVAILABLE FOR WHICH PLEASE ATTACH YOUR BUSINESS LETTER HEADING. FREE CATALOGUE SUPPLIED WITH ALL ORDERS RECEIVED.

VALVES

DK96	7/9	PCF80	7/6	PCF82	9/6
DAF6	6/9	PCC84	7/6	PCL82	9/–
DF96	6/9	PL82	7/6	6V6G	4/–
DL96	6/9	PY83	7/6	6K7G	2/–
ECC81	5/–	UABC80	7/6	6AM6	3/6
ECC82	5/6	UAF42	7/6	EB91	3/–
ECC83	6/–	UBF80	7/6	IR5	5/3
ECC84	7/6	UCH42	7/6	IT4	3/6
ECC85	7/6	UL41	7/6	IS5	4/6
ECH81	7/6	EY51	8/–	3S4	5/6
EBC41	7/6	PL81	8/6	6K8G	4/9
EF41	7/6	PL36	9/6	6L6G	7/6
ECL80	7/6	PCL83	9/6	6X5G	5/–

TERMS: Cash with Order or C.O.D. Postage and Packing Charges extra. Single valves 9d., Minimum Parcel Post charges 2/-. Please include sufficient postage with your order. Minimum C.O.D. fee and postage 3/6. These Postal Rates apply to U.K. only. For full terms of business see inside cover of catalogue. Personal Shoppers 9 a.m. to 5 p.m. Mon. to Friday, Saturday 10 a.m. to 1 p.m.

MICROPHONES:

Acos Mic 39/1	£1 12 6	Acos Mic 40	19 6
Floor stand adaptor	12 6	BM3 Microphone	£2 5 0
Acos Mic. 45	19 6	Floor stands MS4	
Table Stand	12 6	3 sections	£2 19 6
Mic 100C...	£1 19 6	Table top stand	8 0
Table Stand	7 6		

ALPHA RADIO SUPPLY CO. 103 Leeds Terrace, Wintoun Street, LEEDS, 7

5WW—124 FOR FURTHER DETAILS.

CRYSTALS & COMPONENTS LTD.

2-4 EARLHAM STREET W.C.2 TEL. TEM. 1189

Near Cambridge Circus. A few minutes walk from Leicester Square or Tottenham Court Road Underground Stations.

Hours of Business: 9 to 6. Saturdays 9 to 1. Open all day Thursday.

TEST METERS
0/300 m/A. Moving coil 2½in. diam. projecting meter. Brand new 15/-, P. & P. 1/6.
0/200 m/A. Moving coil 2½in. diam. projecting meter. Brand new 15/-, P. & P. 1/6.
0/200 M.croammeter 2½" flush mounting M.C. calibrated 0/100 19/6. P. & P. 1/6.

VARIABLE AIR-SPACED CONDENSERS. 150 PFD, 4/6 each, P. & P. 1/-.

U.H.F. AERIAL
On 10 feet collapsible mast. Spring loaded in 1 foot tubular sections. Complete with 12 feet co-ax. lead and rubber covered plug. 3 steel pegs and nylon guys. Can be easily lashed to existing TV aerials for modification to new frequency. 12/6, plus 2/6 P. & P.

WIRELESS SET NO. 19
Complete with original power supply unit for 12 volts input. Transmitter. Receiver covering 2-8 Mc/s and V.H.F. 240 Mc/s. 6 valve superhet receiver and 6 valves in Transmitter. Using L.F. of 465 Kc/s. For voice and C.W. In good condition not tested. £4/17/6, plus £1 packing and carriage. **Microphone and headset** for this set 17/6, plus 2/6 P. & P. **19 Set Variometers,** 17/6, plus 2/6 post. **Control box for 19 Set,** 10/-, plus 2/- P. & P. **Lead for Control Box,** 12/6, P. & P. 2/-.

TRANSFORMER BARGAINS
Pri: 240 volts Sec: 17 volts 1 Amp. Ideal for small models. 5/-, P. & P. 2/6.
Pri: 200/240v. Sec: 6.3 v. 4 Amps. 8/6, P. & P. 2/6.
Pri: 240v. Sec: 250 v. 60 m/a. & 80v. 100 m/A. 5/-, P. & P. 2/6.
Pri: 240v. Sec: 6.3 v. 2 Amps. 5/-, P. & P. 2/6.

E.H.T. Transformer. Pri: 200/250 volts. Sec: 2,500 volts 10 m/A. 2v. 1.5 A. 6.3 volts .3 Amps. 22/6, plus 5/- P. & P.

H.T. Transformers:
Type HT 2. Pri: 200/240v. Sec: 350/0/350v. 120 m/A. & 3-8-12-18 volts. 5 amps. 35/-, plus 6/6 P. & P.
Type HT 6. Pri: 200/240 volts. Sec: 500/0/500v. 95 m/A. & 0-4-5v. 3 A. 0-4-5-6 .3 A. 0-4-6.3v. 3A. 0-4-6.3v. 2 Amps. 27/6, plus 6/6 P. & P.

Type HT 12. Pri: 110/250 volts. Sec: 225 v. 100 m/A & 6.3v. .5A. 6.3v. 1 Amp. 6.3v. 2.5 Amps. P. & P. 5/-.

46 SETS. Less' original send/receive switch, but supplied with substitute switch with circuit diagram and wiring instructions. Crystals and coil pack with choice of 3.6-4.3 Mc/s or 6.4-7.6 Mc/s. included. Price 18/6, plus 6/- P. & P.

Send S.A.E. for our **NEW CRYSTALS LIST**

TERMS OF BUSINESS CASH WITH ORDER

5WW—125 FOR FURTHER DETAILS.

IMPEX

TRANSISTORS & DIODES

low cost

GENERAL PURPOSE AUDIO TRANSISTORS. TRANSISTOR MATCHED PAIRS. R.F ALLOY-JUNCTION TRANSISTORS. R.F. ALLOY-DIFFUSED TRANSISTORS GENERAL PURPOSE DIODES.

MANY TYPES IN THESE RANGES ARE AVAILABLE FROM STOCK IN BULK QUANTITIES AT VERY ATTRACTIVE PRICES.

IMPEX ELECTRICAL LIMITED
1 GOWER ST., BEDFORD SQ., LONDON. WC1 MUSeum 9777

5WW—126 FOR FURTHER DETAILS.

VITALITY BULBS

FROM 1V to 50V IN SIZES FROM 4.5mm to 18mm DIAMETER

Full information on all types from Vitality Bulbs Ltd. *(The Miniature Bulb Specialists)* Neville Place, Wood Green, London, N.22. *BOWes Park 0016*

5WW—127 FOR FURTHER DETAILS.

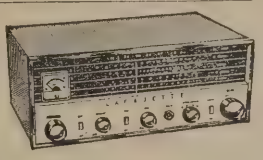
HE-30 SUPER AMATEUR COMMUNICATION RECEIVER

4 bands covering 550 kc/s. to 30 mc/s. continuous. Operation 200/240 volts A.C. Special features include: Easy to read illuminated slide rule dial—built-in Q multiplier — Aerial trimmer — calibrated electrical bandspead on amateur bands —0-100 logging scale — noise limiter — AVC/MVC selector—stable oscillator and B.F.O. for clear CW and SSb. reception — built-in edgewise "S" meter. Output for 'phones or STD. speaker. Supplied brand new and guaranteed with manual. **£42** carriage paid. S.A.E. for full details.

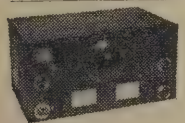
CV2193/89D DOUBLE-BEAM C.R.T.

As used in Cossor 1035 Scope etc. Brand New and Boxed. **59/6** each. P. & P. 4/6.

HE-40 DE LUXE 4-BAND COMMUNICATION RECEIVER



Frequency coverage 550 kc/s. to 30 mc/s. continuous. Operation 220/240 volts A.C. The perfect receiver for short wave listening. Special features include: Slide rule tuning dial—electrical bandspread—0–100 logging scale—improved selectivity—Built in "S" meter—A.V.C.—Noise limiter—B.F.O.—'Phone jack—Built in 5in. speaker—tone control—standby switch—supplied with three aerials, ferrite loop for broadcast band, adjustable 58in. whip for short wave and wire aerial. Smartly styled durable metal cabinet. Supplied brand new and guaranteed with manual. **£24/15/-**, carriage paid. S.A.E. for full details.



NATIONAL H.R.O. RECEIVERS

SENIOR MODEL. Supplied complete with full set of nine coils covering 50 kc/s. to 30 mc/s. Each receiver thoroughly checked before despatch and available as follows:

TABLE MODEL. Good used condition..... **£19 19 0**
RACK MODEL. As new condition..... **£22 10 0**
RACK MODEL. Good used condition..... **£18 18 0**

N.B.—Rack model is identical to table model with extended front panel to fit a 19in. rack. Carriage £1 extra.
200/250 volt A.C. power supplies for all above receivers, also sold separately, **59/6**, carr. 5/-. S.A.E. FOR DETAILS.

LAFAYETTE BRAND RECORDING TAPES

First grade quality American tapes. Brand new and guaranteed. Discounts for quantities.

5in.	600ft. std. plastic	**8/6**
5in.	900ft. L.P. acetate	**10/–**
5in.	1,200ft. D.P. mylar	**15/–**
5½in.	1,200ft. L.P. acetate	**12/6**
5½in.	1,800ft. D.P. mylar	**22/6**
7in.	1,200ft. std. mylar	**12/6**
7in.	1,800ft. L.P. acetate	**15/–**
7in.	1,800ft. L.P. mylar	**20/–**
7in.	2,400ft. D.P. mylar	**25/–**

Postage 2/-. Over £3 post paid.

ERSKINE TYPE 13 DOUBLE BEAM OSCILLOSCOPE

Time base 2 c/s—750 kc/s. Calibrators at 100 kc/s and 1 mc/s. Separate Y1 and Y2 amplifiers up to 5.5 mc/s. Operation 110/230 volt A.C. Supplied in perfect working order.

£27/10/0
Carriage 20/-.

COSSOR DOUBLE BEAM OSCILLOSCOPE 1035

4in. tube. Calibrated Y1 amplifier from 50 mV. to 50 V. Bandwidth 10 mc/s. Calibrated Y2 amplifier from 5 v. to 500 v. with bandwidth up to 100 kc/s. Directly calibrated X shift providing time measurements from 15 microseconds to 150 milliseconds. Supplied in guaranteed perfect condition. **£40** each. Carr. 30/-.

UNIVERSAL AVOMETER MODEL '7'

50 ranges. Guaranteed perfect working order. Supplied complete with leads, batteries and instructions. **£11** each. Reg. post 5/- extra.

MINE DETECTOR No. 4A

Will detect all types of metals. Fully portable. Complete with instructions. **39/6** each. Carr. 10/-. Battery **8/6** extra.

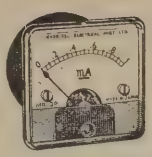
SILICON RECTIFIERS

SCR. 400 v. P.I.V. 4.7 amp. **7/6**
200 v. P.I.V. 6 amp. **5/6**
800 v. P.I.V. 500mA. **5/6**
400 v. P.I.V. 500 mA. **3/6**
70 v. P.I.V. 1 amp. **3/6**

OA202 miniature silicon rectifiers, **1/-** each.

Discounts for quantities. Please add postage.

CLEAR PLASTIC PANEL METERS



● D'ARSONVAL MOVEMENTS ● JEWELLED MOVEMENTS ● 1⅞in. SQUARE FRONTS ● 1¼in. OVERALL BEHIND PANEL ● 1⅛in. DIA. PANEL HOLE ● ACCURACY 2% OF FULL SCALE. ● SILVER DIALS, BLACK NUMERALS AND POINTERS ● FRONT ZERO ADJUSTMENT ●

All types moving coil. Individually boxed and guaranteed. Available as follows:

50μA	32/6	1mA. ...	22/6	300mA.	22/6
100μA.	29/6	10mA.	22/6	500mA.	22/6
200μA	27/6	50mA.	22/6	750mA.	22/6
500μA.	25/–	100mA.	22/6	1A. D.C.	22/6
50–0–50μA.	29/6	150mA.	22/6	5A. D.C.	22/6
100–0–100μA	27/6	200mA.	22/6	3V. D.C.	22/6
10V. D.C.	22/6	750V. D.C.	22/6	150V. DC	22/6
50V. D.C.	22/6	15V. A.C.	22/6	300V. DC	22/6
100V. D.C.	22/6	50V. A.C.	22/6	500V. DC	22/6
				150V. A.C.	22/6
				300V. A.C.	22/6
				500V. AC	22/6

Calibrated "S" meters **35/-**. A FULL RANGE OF LARGER CLEAR PLASTIC AND BAKELITE PANEL METERS ARE AVAILABLE. SEND FOR ILLUSTRATED LEAFLET. TRADE TERMS AVAILABLE.

FIELD TELEPHONES

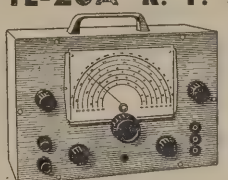
Type "L" 2 line connection, generator bell ringing. Complete telephone intercom. Supplied in excellent condition, fully tested and complete with batteries. Only **69/6** per pair. Carr. 5/-.

Type "F" As above but moulded bakelite case (as illustrated). Supplied complete with wooden transit case for field use, **£4/19/6** per pair. Carr. 5/-.

MARCONI TF 144G/4 STANDARD SIGNAL GENERATORS

First release of this late mark. 85kc/s to 25 mc/s ± 1%. Output variable from 1μV to 1 volt. Internal sine wave modulation 400 c/s up to 75% depth. Operation 200/250 volt A.C. Offered in excellent condition. Ex-ministry, untested without leads **£16/10/-** or tested and guaranteed **£25.** Carr. 30/-.

TE-20A R. F. SIGNAL GENERATOR



A precision signal generator of extremely high accuracy and quality. Six ranges from 120kc/s to 130 mc/s on fundamentals with calibrated harmonics from 120 to 390 mc/s. 400 cps. INT. MOD. OR EXT. MOD. OUTPUTS, MOD R.F., UNMOD. R.F. OR 400 c/s audio. R.F. output in excess of 100 mv. Large clear 5-inch dial. Handsome grey metal case with handle. Size 7½in. x 10¾in. x 4½in. Complete with leads. Operation 220/240 volts A.C. Supplied brand new and guaranteed. **£12/19/6.** Carr. 5/-.

P.C.R.2 COMMUNICATION RECEIVERS

Excellent 6-valve receiver. Frequency coverage on 3 bands, 800–2,000 metres, 190–550 metres and 6–22 mc/s. Output for phone or speaker. Supplied in perfect condition **£5/19/6** each. Carr. 10/-. The receiver can be supplied with an internal power supply to operate on 200/250 volt A.C. at **39/6** extra or plug in external power supplies are **35/-** extra. Full circuit supplied.

AVO WIDE RANGE SIGNAL GENERATORS

Frequency coverage 50 kc/s. to 80 mc/s. xi six turret operated ranges. For use on standard A.C. mains. Packed in original transit cases with accessories. Supplied in as new condition, fully checked before despatch. **£15.** Carr. 10/-.

MINIFLUX ¼-TRACK TAPE HEADS

Set of three, record, playback, erase. Only **29/6** set. P.P. 9d.

MICROAMMETERS

0–500 microamp., 2½in. circular flush panel mounting. Dials engraved 0–15, 0–600 volts. Brand new boxed, **15/-.** P. & P. 1/6.

HEAVY DUTY AUTO. TRANSFORMERS

0/115/230 volt step up or step down. Brand new boxed ex-U.S.A. 3,000 watt **£7/10/-**, carr. 10/-. 7,500 watt, **£15**, carr. £1.

OPEN 9 a.m.-6 p.m. EVERY DAY, MON.-SAT.

CR.100 COMMUNICATION RECEIVERS

60 kc/s. to 30 mc/s. on 6 bands. 200/250 volt A.C. operation. Supplied in perfect working condition. **£21** each. Carr. 30/-.

MARCONI TF-885 VIDEO OSCILLATORS

20 c/s to 5 mc/s sinewave and 500 c/s-150 kc/s squarewave. Eleven position attenuation. Operation 110/200/250 volts A.C. Supplied in perfect condition. **£45.** Carriage 30/-.

E.M.I. WM.5A CONSUL OSCILLOSCOPES. Available as new, guaranteed perfect condition. **£110** each.

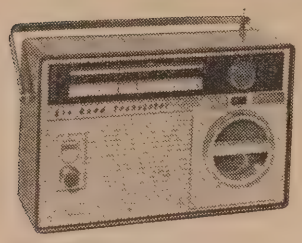
G.W. SMITH & CO (RADIO) LIMITED

Phone: GERRARD 8204/9 55
Cables: SMITHEX LESQUARE
3-34 LISLE STREET, LONDON, W.C.2

5WW—128 FOR FURTHER DETAILS.

HOME CONSTRUCTORS LOOK—

AT THIS OUTSTANDING RANGE OF TRANSISTORISED RADIOS!!



THE SKYROVER. Individual Details—controls: Waveband Selector. Volume Control with on/off switch. Tuning Control with easy to read Dial Scale. In attractive plastic cabinet, size 10 × 6½ × 3½in., with metal trim and carrying handle.
MAY BE BUILT FOR **£10.19.6**
All parts sold separately.

THE SKYROVER | THE SKYROVER De Luxe

GENERAL SPECIFICATION FOR BOTH MODELS

7-transistor and 2 diode superhet—6 waveband portable receiver, covering the full Medium Waveband (180-576 M) and Short Waveband (32-94 M) and in addition 4 separate switched Band Spread Ranges on 13M, 16M, 19M, and 25M/bands—with manual Band Spread Tuning for accurate Station selection. I.F. frequency 470 Kc/s. Output 500 MW. 5in. Ceramic Magnet P.M. Speaker. Telescopic and internal Ferrite Rod Aerial. All Mullard Transistors and Diodes. The coil pack and tuning heart is completely factory assembled, wired and tested. The remaining assembly can be completed in under three hours from our detailed and easy to follow instructions. Operates on four 1.5v. torch batts. (U2 or equivalent).

Circuit diagram and data for each set 2/6 extra, free if all parts bought. Four U2 batteries 2/8 extra. Four Leak-Proof Batteries. 3/4 extra.

Add 5/- P. & P. on each parcel.

THE SKYROVER DE LUXE

Tone Control Circuit is incorporated with separate Tone Control in addition to Volume and Tuning Controls and Waveband Selector. In sturdy wood cabinet, size: 11½ × 6½ × 8in. covered in washable material with plastic trim and carrying handle. Also Car Aerial socket.
MAY BE BUILT FOR **£12.19.6**
All parts sold separately.

READY BUILT BARGAINS

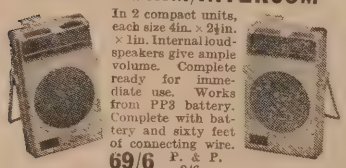
2-TRANSISTOR POCKET RADIO FULLY BUILT PLUS ALL EXTRAS
Ready made as illustrated—complete with personal earpiece, telescopic aerial, battery and carrying case! Wonderful value and performance—full medium waveband coverage—built in 2½in. speaker gives full tone reproduction. Works on single PP3 9 v. battery. In attractive plastic case—size only 4 × 2½ × 1in. All accessories included in the price.

WIRECOMP'S PRICE COMPLETE **42/-** POST FREE

ALSO 6 TRANSISTOR POCKET RADIO—FULLY BUILT
Wonderful performance. Tunable over full medium waveband. Built in 2½in. speaker. In attractive plastic carrying case—size 4 × 2½ × 1in. Operates on single PP3 9 v. battery. Supplied complete with personal earpiece, leather carrying case and battery.
WIRECOMP'S PRICE COMPLETE **79/6** POST FREE

TRANSISTOR INTERCOMS

BABY ALARM/INTERCOM



In 2 compact units, each size 4in. × 2½in. × 1in. Internal loudspeakers give ample volume. Complete ready for immediate use. Works from PP3 battery. Complete with battery and sixty feet of connecting wire.
69/6 P. & P. 2/6.

THE 'RAINBOW'

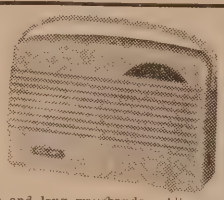
A high powered 2 station intercom, ideal for shops, offices, etc. Complete with flex. **£6.19.6** P. & P.

CRYSTAL PICK-UP CARTRIDGES

All Complete with Styli. Add 1/- P. & P.

MONO Type C.T.1. By well-known manfr. With 2 sapphire styli	9 6
Garrard Ceramic G.C.E.4.	15 0
Garrard Magnetic T.O.M.2	15 0
Acos. G.P.59	14 0
Acos. G.P.65/3	15 0
Acos. G.P.65/1	17 0
Acos. G.P.67/1	14 0
STEREO Acostereo 73/1, with 2 sapphires	25 0
Acostereo 73/2, with Diamond LP/Stereo and sapphire Std.	29 6
Collaro type C Turnover, with 2 sapphires	19 11
Collel S.C.I. Turnover, with 2 sapphires	19 11
Collel S.C.I. Turnover, with Diamond L.P./Stereo and sapphire Std.	25 0
Ronette Stereo G.V. Turnover, with 2 sapphires	25 0
Ronette Stereo types 105 and 106 with 2 sapphires	35 6
Ronette Stereo types 105 and 106 with Diamond L.P. Stereo and sapphire Std.	39 6

THE 'REALISTIC 7'



A fully transistorised Portable Receiver made to the highest professional standards—is now available to the home constructor. Comprises 7 Mullard Trans., OC44, OC45's, OC71, OC81D, and 2 OC81's plus OA70 Crystal Diode. Delivers 350 milliwatt output to 4in. high flux speaker—I.F. frequency 470 Kc/s—fully tunable over medium and long wavebands. All components mounted on single printed circuit board, size 5½ × 5½in. Attractive two-tone plastic cabinet with carrying handle—size 7 × 10 × 3½in. with easy to read dial and socket for car aerial, choice of Red/Grey, Blue/Grey or all Grey. Complete with full instructions.

All parts sold separately
MAY BE BUILT FOR **£5.19.6** Battery 3/9 extra.
P. & P. 4/6 extra. (Circuit diagram 2/6 free if all parts bought.)

AND 'REALISTIC 7' DE LUXE

A "De-Luxe" version of the well-known "Realistic 7" is now available, with the same specification as the standard model PLUS a restyled superior wood cabinet covered in attractive washable material with chrome trim and carrying handle, AND ALSO a full vision circular tuning dial (externally mounted) to further improve this wonderful set. **Only £1.0.0 extra** P. & P., etc., as Standard Model.

THE 'SPRITE'

A six transistor superhet Miniature Pocket Radio of Commercial Quality. Fully tunable over Long and Medium wavebands. Uses printed circuit and high sensitivity internal ferrite rod aerial. I.F. frequency 470 Kc/s. Transistors: 3-Philco 2067s, 2-Mullard OC81M, OC81DM and OA90 diode, 3 inch speaker. Works on single PP3 battery. Supplied with the complete RF and IF stages, driver and output stages, ready built and mounted on the printed circuit: for final assembly you have only to fit the wave-change switch, tuning condenser and drive, volume control, earphone socket and aerial rod. In very attractive plastic case, size 4 × 2½ × 1½in.
MAY BE BUILT FOR **79/6** All parts sold separately
Real Calf Leather Case, wrist strap and Personal Earphone with case, and battery 12/6 extra.
P. & P. 3/6 extra. (Data and instructions 2/6, free if all parts bought.)

E.M.I. 4-SPEED RECORD PLAYER

New, unused and individually boxed, fitted with lightweight pick-up with ACOS G.P. 73/2 stereo cartridge. Cabinet space required 13½ × 12½ × 4½ inches. A 9-inch metal turntable is fitted. For use on 200/250 volt A.C. mains, with Auto-stop. The stereo cartridge will play all types of Mono Records, 78's, L.P.'s etc., but if desired a G.P. 67 L.P./78 Mono cartridge will be supplied in lieu of the G.P.73 at no difference in cost.
P. & P. 3/6. Price **79/6**

STOCK ITEMS

	Add 5/- P. & P. on each.
B.S.R. UA14 4 speed auto.	£5 19 6
GARRARD Auto-Slim Mono	£6 10 0
GARRARD Auto-Slim Mono plug-in head	£7 7 0
GARRARD Auto-Slim De Luxe Mono	£11 5 0
GARRARD Auto-Slim De Luxe Stereo	£12 5 0
GARRARD T.A. Mk. II single play Mono	£7 17 6

AMPLIFIERS

8 WATT MONO AMPLIFIER

Made by well-known manufacturer. Spec.: 2-EL84 1-EZ80 and 1-ECC83 Push-Pull output. Separate Bass and Treble controls on panel with extended lead.
P. & P. 3/6. **£5.5.0**

AND NOW the above amplifier with its well-proven specification is available to you as a 2 × 4 watt STEREO AMPLIFIER. Two output transformers and two speaker outputs—for little extra cost!
ONLY £6.19.6 P. & P. 5/- extra.

ADASTRA 3-3 AMPLIFIER

Three watt output, built to the well known 3-3 design. with volume, bass and treble controls. Size 9in. × 7in. × 4in. Attractively styled face plate, etc. Ready built.
WIRECOMP'S PRICE **£4.1 .6** P. & P. 5/-.

U.H.F. TUNERS

Only a few available. Complete with P.C.88 and P.C.86 valves. Fully variable tuning capacitor, etc. British manufacture. New and unused. Size 4½in. × 5½in. × 1½in. We regret no circuit or data available.
WIRECOMP'S PRICE **59/6** P.&P. 2/6.

FM TUNER CHASSIS OFFER

A factory built FM Tuner using the Gorler front end unit and I.F.'s Freq. range: 88-108 Mc/s. Valve line up: 6AL5; 3 × 6AU6; ECC85. Fully assembled on printed circuit. Illuminated glass dial. Overall size 12 × 5 × 3in. Unpowered—requires 6.6 v. L.T. and 200 v. at 40 mA. H.T. Full circuit data included.
WIRECOMP'S PRICE **£5.19.6** P. & P. 6/-.

THE PETIT FULMITER

A.C. ELIMINATOR AND 9v BATTERY CHARGER **18/6** P. & P. 4/6
Converts your Miniature Transistor Set to Mains for the winter. For use with all 9 v. transistor receivers (approx. same size as PP3 battery).

TAPE

FULLY GUARANTEED, AT RECORD LOW PRICES
Famous make, P.V.C. base on latest type plastic spools. New, perfect, boxed, guaranteed.

1,200ft. on 7in. spool	12 6
1,800ft. on 7in. spool	19 6
1,200ft. on 5½in. spool	15 0
850ft. on 5½in. spool	11 0
600ft. on 5in. spool	8 6
225ft. on 3in. spool	4 11
2,400ft. D.P. on 7in. spool	25 0

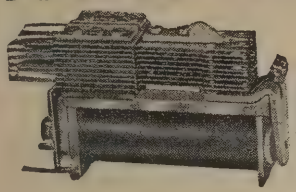
WIRECOMP ELECTRONICS

378 HARROW ROAD, LONDON, W.9. TEL.: CUNNINGHAM 9530

Hours of Business: 9 a.m. to 6 p.m. Open all day Saturday Opposite Paddington General Hospital. Buses 18B and 36 pass the door.

Wilkinsons

EST. 1921



RELAYS

P.O. TYPE 3000 AND 600
Built to your own specification
Keen Prices
Quick Delivery
Contacts up to 8-Changeover

RELAYS MAGNETIC SOLENOID OPERATED

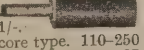
24 volts D.C. 4 make and 4 break 10 amp. contacts. 5C/3044. Brand new, complete, with dust cover, **12/6** each, post 2/-.

SUBMINIATURE MICRO SWITCHES

HONEYWELL IISMI—TN13 6/6 EACH

KEY SWITCHES (3 position). P.O. 212. 2 Changeover each side, **6/6.**
P.O. 198. 4 Changeover each side, **13/6.**
Other types available, ask for details.

MIRROR GALVANOMETERS BB 3000. N.E.P. Focal length 20 cm. **£18.**
RACKS—POST OFFICE STANDARD. 6ft. high with U-channel sides drilled for 19in. panels, heavy angle base.
JACK PLUGS. Cylindrical Bakelite screw-on cover, 2 contact, **2/6,** post 6d. Large quantities available. Also PO. 201 on headphone cord 10H/117 **3/-** ea. Post 1/-.

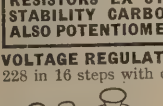


AUTO TRANSFORMERS by S.T.C. Totally enclosed C core type. 110–250 volts. 8 tappings. 50 cycles, size $6\frac{1}{2} \times 5\frac{3}{4} \times 5\frac{1}{2}$. 500 watts. New latest type **£5**
MAINS TRANSFORMER. Input 200/250 volts. Output 300-0-300 volts, 250 mA., 6.3 volts, 9 amps. **25/-,** post 3/-.

WESTALITE BATTERY CHARGERS. Made by Westinghouse (type BC14–6/40). Input 200/250 v. A.C. will charge 6-volt or 12-volt batteries at 0/40 amps. Coarse control switch with eight positions and fine control switch with four positions including "off." Built-in 0-50 ammeter. Fused A.C. and D.C. 24in. × 14in. × 13in., **£39/10/-** each. Carriage 20/-.
15-AMP. BATTERY CHARGER. (Westinghouse Type BC.3) will charge three lead acid cells at 15 amps. Input 200/250 volts, 50 cycles A.C. Charging current regulated by four-position switch and variable resistance for fine control. Fitted with 0/20 ammeter, rotary on/off switch and rewirable fuses. **£8/10/-.** Carriage 15/-.

RESISTORS EX STOCK IN QUANTITY. WIRE WOUND, HIGH-STABILITY CARBON ETC., BEST MAKES AT LOWEST PRICES. ALSO POTENTIOMETERS AND CONDENSERS AVAILABLE.

VOLTAGE REGULATORS. Input 230 v. A.C., 21 amp. Output 57.5 v. to 228 in 16 steps with current limiting reactor, **£20** each, carriage 15/-.



MORSE KEYS. Precision instrument made to inter-service specifications. Fully adjustable within fine limits. Overall size 5in. × $1\frac{1}{2}$in. × 2in. Brand new **10/6.** Post 1/6.

BATTERIES. Portable Lead Acid type 6 volt 125 ampere hours. In metal case 16in. × 8in. × 11in. Uncharged **£6/10/-** each, carriage 15/-.
MIDGET SILICON RECTIFIERS. 800 P.I.V. Suitable for replacements up to 500 Milliamps. **7/6** ea.
MIDGET SILICON RECTIFIERS. 200 P.I.V. 70 volts R.M.S. 6 amps. Using a suitable transformer anything up to 70 volts and 6 amps. can be obtained. **12/6** ea.
MIDGET SILICON RECTIFIERS. 100 vt. 200 Milliamps. Many uses—operating D.C. Relays. building computers, etc. **5/-** ea.
SILICON RECTIFIERS. 600 P.I.V. 700 Milliamps. S.T.C. RS27AF. Specially selected for precision work. **30/-** each.
TRANSISTORS. OC44 **9/-;** OC45 **9/-;** 2S002 **15/-;** OC71 **6/6;** OC200 **21/-;** V30-30P **10/6.**

MINIATURE SILVER ZINC ACCUMULATOR. 1.5 volts, 1.5 ampere. Size 2in. × 1.13in. × 0.63in. Weight $1\frac{1}{2}$ oz. Ideal for model work, **15/-,** post 9d.
LEDEX SOLENOID DRIVEN WAFER SWITCHES. Operating from 24 volts with standard size wafers. Available in 4 bank, 14 bank, 24 bank, all 1 pole 11-way. Prices from **90/-.**
TRIMMING CONDENSERS. Air spaced miniature 1.5 to 8 pf., 1.5 to 20 pf., 2 to 32 pf., 20 pf. All at **1/6** each, post 3d.
CONDENSERS METALMITE. 350 vt. wkg., .001, .002 miniature, **12/-** doz., .005, .01, .02 **10/-** doz., .05 **12/-** doz., .1 **13/6** doz., .25 Metalpack **16/-** doz., 1.0 Metalpack, **24/-** doz. Post 1/-.

TELEPHONES

Easy to Fix Wiring Diagram Free

TELEPHONE SET TYPE "A" Ringing and speaking both ways on a 4-core cable. Very loud and clear over any distance. The handsets are as illustrated and the set is complete except wire. 4-core at **10d.** per yard extra. Price **75/-** set, post 4/-.
SET B. Two headphones connected to breast microphones, with leads, plugs and fitted carrying cases. Join instruments together with two wires and $1\frac{1}{2}$ volt battery for a super Intercom., **37/6,** post 4/-.

MINIATURE SEALED RELAYS

OVER 120 TYPES IN STOCK. SEND FOR LIST.

SIEMENS 1 C.O.

2.2Ω + 2.2Ω		H96A	**19/6**
50Ω + 50Ω		H96B	**22/6**
145Ω + 145Ω		H96C	**22/6**
1,700Ω + 1,700Ω		H96E	**25/-**

G.E.C.

2,500Ω	4CO	M1008	**22/6**
2,500Ω	1CO	M1022	**19/6**
5,000Ω	2CO	M1052	**21/6**
670Ω	2m2bHD	M1095	**21/6**
2Ω	2CO	M1409	**21/6**
2,500Ω	2C2K	M1417	**22/6**
5,000Ω	2CO	M1452	**21/6**
2Ω	2mHD	M1454	**21/6**
2,500Ω	2mHD	M1458	**21/6**
2,500Ω	1m1bHD	M1462	**21/6**
40Ω	2CO2K	M1482	**22/6**
180Ω	1CO	M1486	**19/6**
180Ω	2m2bHD	M1487	**21/6**
180Ω	2C2K	M1490	**22/6**
670Ω	2C2K	M1493	**22/6**
670Ω	2mHD	M1499	**21/6**
670Ω	4K	M1567	**22/6**
670Ω	2B2K	M1572	**21/6**
180Ω	4K	M1574	**22/6**

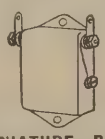
S.T.C.

45Ω	1mHD	4186EB	**19/6**
170Ω	1mHD	4186EC	**19/6**
2,500Ω	2CO	4184GE	**19/6**
2,500Ω	1mHD	4190EE	**19/6**

ERICSSON

7,000Ω	1CO	N22242A10	**25/-**
14,000Ω	1CO	N22242A1	**37/6**
260Ω	1CO	N22372AC1	**19/6**
5,000Ω	1CO	N22372AE1	**19/6**
7,500Ω	2CO	N22365AZ1	**21/6**
1.1Ω	4CO	N22364AA1	**22/6**
1.1Ω	2CO2K	N22366AA1	**22/6**
1,500Ω	2CO2K	N22366AE1	**22/6**
2.4Ω	2M	N22371AA1	**21/6**
180Ω	2M	N22371AC1	**21/6**
2,000Ω	2M	N22371AE1	**21/6**
2.4Ω	1m1b	N22370AA1	**21/6**
52Ω	1m1b	N22370AB1	**21/6**
180Ω	1m1b	N22370AC1	**21/6**
1,500Ω	2m2b	N22369AE1	**21/6**
7,500Ω	2m2b	N22369AZ1	**21/6**
1.1Ω	2M2K	N22374AA1	**22/6**
1,500Ω	2B2K	N22613AE1	**22/6**
7,500Ω	2B2K	N22613AZ1	**22/6**

M.E.S. BULBS. BEST QUALITY
2.5 Vt. 0.15 amp. 11 mm. round **20/-** per 100
2.5 Vt. 0.2 amp. 11 mm., round, **20/-** per 100
A few of the above are available with Store Soiled Bases at the reduced price of 17/6 per 100.
4 Vt. 0.3 amp. 15 mm. round, **15/-** per 100
6.2 Vt. 0.3 amp. 15 mm. round, **37/6** per 100
6.2 Vt. 0.3 amp. 9 mm. tubular, **8/-** per doz.
These are excellent British Bulbs and not to be confused with the cheap Foreign Makes and the prices are inclusive of any Purchase Tax.
PROJECTION LAMPS. Class A1. Prefocus Cap 115 volts 750 watts. **25/-** each, post 1/6.



MINIATURE BUZZER. 12 v. with adjustable tone. Operates well on 6 volts, **7/6,** post 9d.

Microammeters, Milliammeters, Voltmeters

BEST MAKES ★ DELIVERY OFF THE SHELF ★ SEND FOR LISTS

2½in. Moving Coil Flush Round
0/1 amp.; 0/5 amp.; 0/10 amp.; 0/20 volts; 0/30 volts; 0/40 volts; all at **35/-** each. 0/30 amps. **42/6.**

2in. Moving Coil Flush Round
0/1 Milliamp; 0/5 Milliamp; 0/10 Milliamp; 0/20 volts; 0/30 volts; 0/40 volts; all at **27/6** each.

2in. Moving Coil Flush Square
0/1 Milliamp at **37/6.** **Postage on all meters 2/-.**

MILLIAMMETER. 0/100 D.C. 9in. PR. Have a meter you can read easily. **150/-.**
CELL-TESTING VOLTMETERS. 3-0-3 volts D.C. In leather case with prods. Just the job for the car. **25/-** ea.
MICROAMMETERS. 500 microamp A.F.S.D. scaled 15 and 600 volts MC 2in. flush round. Ideal for conversion. **20/-** each.
MICROAMMETERS. 50 microamp A.F.S.D. scaled MilliRontgens MC 2½in. PR. Ideal for conversion, **45/-** each.
CONTACT VOLTMETERS. 55/65 Vt. Moving Coil, 9in. Ironclad. **150/-** ea.
FREQUENCY METERS. 45-55 cycles per second. 230 volt, 6in. dia. Flush Round. Brand new in maker's box. **£10/10/-,** post 5/-.
AMMETER. 0-3 amps. D.C. by Turner, MC/FR, 6in., **90/-,** post 3/6.
UNI-PIVOT GALVANOMETER, by Cambridge Instruments, 50-0-50 microamps. dia. 4in. Knife pointer, mirror scale. Complete with leather carrying case. Ideal for laboratory use, **£10,** post 3/-.
PORTABLE AMMETER. 0-3 amp. A.C./D.C. 3in. scale in case with handle **35/-,** post 2/6.
AMMETER, reading 50-0-50 amp., 2in. Flush Square, **17/6** each, post 2/-.
VOLTMETER. A.C. 0/300 2½in. Flush Round, **25/-,** post 2/-.
AVO TEST BRIDGES. 220/240 volt A.C. Measure capacities from 5 pf. to 50 mfd. and resistances from 5 ohms to 50 megohms. Valve voltmeter range 0.1 to 15 volts and condenser leakage test, **£9/19/6,** post 5/-.
BRIDGE MEGGERS. Evershed and Vignoles 500 volt series II complete in leather case, **£40,** carriage paid.
BRIDGE MEGGER TESTING SET SERIES 1. With resistance box and leads 1,000 v., 0-100 megohms. Usual price £189. **Our price £75.**
SIGNAL GENERATOR TYPE 52A. Input 230 volt 50 cycles, complete with leads, dummy antenna. Brand new in transit case. 6 to 52 Mc/s. inclusive in 4 bands with calibration charts. Coarse and fine attenuators. Int. and ext. mod. Output 0.5 volt to 100 mv. impedance 70 and 100Ω. **£10.** Carriage 10/-.
KILOWATT METER 3.5KW. 3-phase 440 volts 50 cy. Balanced load 6in. proj. Round with external resistance box. By Elliott Bros. **£15.**
A.C. MOVING IRON METERS. 4in. suitable for flush or projection fitting. Matching type 600 volts. **110/-.** 100 amp. **80/-.** post 3/6.

ONE HOLE FIXING SWITCHES

12/- per dozen 75/- per 100

SINGLE-POLE Double Throw, 3 amp. 250 A.C.
Can be used as ON/OFF or CHANGE-OVER SWITCH

L. WILKINSON (CROYDON) LTD.

LONGLEY HOUSE LONGLEY RD. CROYDON SURREY
Phone: THO 0216 Grams: WILCO CROYDON

STERN-CLYNE

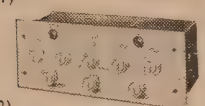
INCORPORATING STERN RADIO LTD., PREMIER RADIO, CLYNE RADIO LTD.

★ STEREO AMPLIFIERS ★

(1) MULLARD "10 Plus 10" STEREO AMPLIFIER.

A High Fidelity design providing up to 10 watts (per channel). Superb reproduction. Frequency response flat to within 3 dB from 3 c/s to 60 Kc/s at 50 mW. Total harmonic distortion at 10 watts 0.1%. Built to the highest technical standards and presented strictly to MULLARD'S Specification. Two specially designed GILSON ULTRA LINEAR OUTPUT TRANSFORMERS with 20% taps are used.

KIT OF PARTS **£20.0.0** BUILT AND TESTED **£24.0.0** (C. & I. 7/6.)



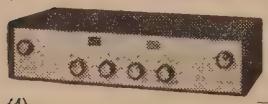
We can also supply the **MAIN AMPLIFIER** for operation with our DUAL CHANNEL PRE-AMPLIFIER: this provides for a more versatile installation and is essential if a low output Pick-up is to be used. When ordering specify loudspeaker impedance.

KIT OF PARTS **£27.0.0** BUILT AND TESTED **£34.0.0** (C. & I. 10/6.)

(2) MULLARD DUAL CHANNEL PRE-AMPLIFIER.

A four-valve design for both STEREOPHONIC and MONOPHONIC operation. Operates equally well with any make of Amplifier requiring input of up to 250 mV.

KIT OF PARTS **£12.10.0** BUILT AND TESTED **£15.0.0** (C. & I. 5/-.)



(3) THE "TWIN THREE" STEREO AMPLIFIER.

Based on a recent design by MULLARD LTD. it is ideally suited for use in PORTABLE RECORD PLAYERS for which purpose we offer a specially designed case: it incorporates MULLARD ECL86 valves, separate BASS and TREBLE CONTROLS, PARTRIDGE output transformer producing up to 3 watts per channel. Frequency response is 40 c/s to 35 Kc/s. Size 11½ × 3 × 5in.

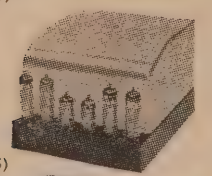
BUILT AND TESTED **£9.0.0** (C. & I. 7/6.)

To construct a STEREO PORTABLE RECORD PLAYER we offer:—
Assembled AMPLIFIER with two ROLA 8 × 5in. LOUDSPEAKERS and PORTABLE CASE for **£16/10/-**. (C. & I. 10/-.)

(4) THE "TUDOR" STEREO AMPLIFIER.

A self-contained shelf mounting Amplifier designed to provide high quality stereophonic and monophonic reproduction. Each channel provides a rated output of 6 watts and for monophonic operation approx. 12 watts is produced. Separate BASS and TREBLE CONTROLS. The Cabinet is finished in black crackle. Size 14 × 8 × 4in. Send for full specifications.

PRICE ONLY **£15.0.0** (C. & I. 7/6.)

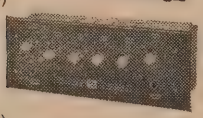


(5) TUDOR STEREO HI-FI SYSTEM.

Comprising a self-powered AM/FM Tuner, Stereo Pre-amplifier and 12 watt per channel Stereo Power Amplifier. The Tuner and Pre-amplifier are housed in matching black crackle finish metal Cabinets for shelf mounting, with silver metal dials and matching knobs. SPECIFICATIONS: Tuner—outstanding quality providing full VHF/FM Long and Medium waveband coverage, frequency range FM 87.5-108.5 Mc/s. AM MW 522-1,630 Kc/s. LW 145-270 Kc/s. 100 mV output mains supply 105/240 v. A.C. Valve line-up: ECC85, ECH81, EBF89, EF80, EB91, EM84, ECC83. Multiplex outlet provided. **Pre-Amplifier**—Designed for use with the Tudor Stereo Power Amplifier with inputs for most types of Pick-ups, direct play from Tape Heads and ample sensitivity for either Crystal or Moving Coil Microphone. Distortion .1% tape output 100 mV from 90 K/ohm source, inputs—Microphone 5 mV, Tape 3.5 mV, R.I.A.A. 4.3 mV, flat 250 mV, Tuner 100 mV. Valve line-up: 2-EF86, 4-ECC83. **Power Amplifier**—14 watts per Channel, sensitivity 1 volt r.m.s. for 14 watts output, frequency response +0.5 dB 20 c.p.s. —20 Kc/s, Speaker impedance 4, 8, or 16 ohms. Surplus power available for tape pre-amplifier. Mains supply 105/240 v. A.C. Valve line-up—2-ECC83, 4-EL84, 1-GZ34

ALL FOR ONLY **48 Gns.** (C. & I. 15/-.)

★ MONO AMPLIFIERS ★



(6) MULLARD 3-VALVE PRE-AMPLIFIER TONE CONTROL UNIT.

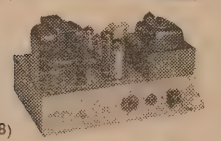
Designed mainly for the STERN/MULLARD range of Monophonic Power Amplifiers, but also suitable for any Amplifier requiring an input signal up to 250 mV. Five inputs, including one equalised for replay direct from high impedance tape head, and one for low output magnetic pick-up. Output for tape record. Separate Bass and Treble controls. High Pass Filter 20 to 160 c/s. Low Pass Filter 5 to 9 kc/s. Power requirements—250 v. at 6 mA, 6.3 v. at 0.8 amps. Totally enclosed case silver hammered. Size 11½ × 4½ × 4in. Front panel in polished Perapex with choice of black or white.

KITS OF PARTS **£10.0.0** BUILT AND TESTED **£13.13.0** (C. & I. 5/-.)

(7) MULLARD 2-VALVE PRE-AMPLIFIER TONE CONTROL UNIT.

Employing two EF86 valves and designed to operate with the Mullard MAIN AMPLIFIERS but also perfectly suitable for other makes. Equalisation for the latest R.I.A.A. characteristics. Input for Crystal and low output magnetic pick-ups. Input (a) Direct from High Imp. Tape Head; (b) from a Tape Amplifier or Pre-Amplifier. Sensitive Microphone Channel. Wide range BASS and TREBLE Controls.

KIT OF PARTS **£6.6.0** BUILT AND TESTED **£9.10.0** (C. & I. 5/-.)

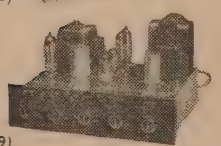


(8) MULLARD "5-10" MAIN AMPLIFIER.

For use with MULLARD 2- or 3-valve pre-amplifiers with which an undistorted power output of up to 10 watts is obtained. SPECIFIED COMPONENTS AND MULLARD VALVES including PARTRIDGE MAINS TRANSFORMER and choice of PARMEKO or PARTRIDGE Output Transformer.

KIT OF PARTS **£10.0.0** BUILT AND TESTED **£13.10.0** (C. & I. 5/6.)

ABOVE INCORPORATING PARTRIDGE OUTPUT TRANSFORMER **£1/6/-** extra.



(9) MULLARD "5-10RC" AMPLIFIER.

The popular "5-10" complete incorporating Passive Control Unit providing up to 10 watts high quality reproduction with an input of 600 mV. Specified components include new MULLARD VALVES, PARTRIDGE MAINS TRASFORMERS and choice of the latest PARMEKO or PARTRIDGE Output Transformers. Surplus power available for tuner.

KIT OF PARTS **£12.0.0** BUILT AND TESTED **£16.0.0** (C. & I. 7/6.)

WITH PARTRIDGE OUTPUT TRANSFORMER **£1/6/-** extra.

(10) MULLARD "3-3RC."

A HIGH QUALITY AMPLIFIER DEVELOPED FROM THE VERY POPULAR 3-WATT MULLARD "3-3" DESIGN. Complete to the MULLARD specification including PARMEKO OUTPUT TRANSFORMER. Switched inputs for 78 and L.P. records plus a Radio position. Power to drive a Radio Tuner is also available.

KIT OF PARTS **£8.8.0** BUILT AND TESTED **£11.10.0** (C. & I. 6/6.)

INSTRUCTION BOOKS AND DETAILED PRICE LISTS are Supplied Free with Kits of Parts but may be purchased separately if required.

Items 1, 2 and 14, **3/-** each; 6 and 13, **3/6** each; 7, 8, 9, 10 and 21, **2/-** each; 11, 15 and 20, **2/6** each; 12, **5/-**. All Post Free. (Instruction booklet for item 19 is same as item 14.)

IF YOU ARE PLANNING TO INSTALL HI-FI

and uncertain of the type of equipment to use—our widely experienced technical staff will with pleasure put forward recommendations. State type of installation contemplated and approx. price level. Credit Sale Terms are available on all equipment over **£10.** Send S.A.E. for fully descriptive leaflets on items of interest and copy of our interesting little booklet, "**What is High Fidelity?**"

COMBINED PRICE REDUCTIONS

(a) The KIT OF PARTS to build both the "**5-10**" **Main Amplifier** and the **2-valve Pre-Amplifier**.... **£15.15.0**

(b) KIT OF PARTS to build the "**5-10**" **Main Amplifier** and **3-Valve Pre-Amplifier** **£19.10.0**

(C. & I. 8/6 extra)

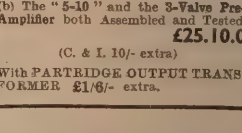
(a) The "**5-10**" and the **2-valve Pre-Amplifier** both Assembled and Tested **£21.10.0**

(b) The "**5-10**" and the **3-Valve Pre-Amplifier** both Assembled and Tested **£25.10.0**

(C. & I. 10/- extra)

With PARTRIDGE OUTPUT TRANSFORMER **£1/6/-** extra.

(11) THE "MONO-GRAM"



A small Amplifier of genuine high quality performance. Incorporates MULLARD ECL86 Valve, separate BASS and TREBLE controls, PARTRIDGE Output Transformer producing up to 3 watts undistorted output.

KIT OF PARTS **£4.10.0**

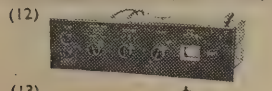
BUILT AND TESTED **£6.0.0**

(C. & I. 3/6.)

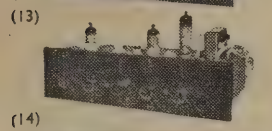
THE "MONO-GRAM" is perfectly suited for Portable Installations for which purpose we offer—PORTABLE CASE **£3/10/-**; the AMPLIFIER (Kit) and 8 × 5in. SPEAKER (**£1**). All for **£9** or with **ASSEMBLED AMPLIFIER £10.** (C. & I. 5/-.)

The case quoted above will accommodate some 4-speed Single Record Units. A larger model for autochange is available for extra **10/-**. With this Equipment a COMPLETE PORTABLE RECORD PLAYER can be built for **£14.**

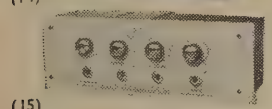
(12)



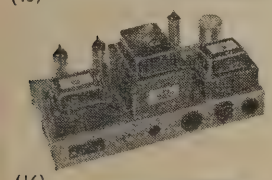
(13)



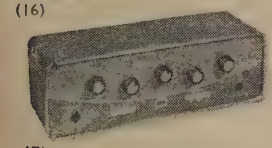
(14)



(15)



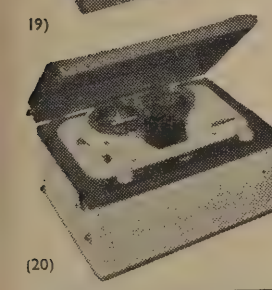
(16)



17)

(18)

19)



(20)

(12) STEREO TAPE PRE-AMPLIFIER Model STP-1.

For use with current TRUVOX, BRENELL or COLLARO "STUDIO" ¼- and ½-track Stereo Decks. Incorporates Ferroxcube Oscillator, 4-speed Equalisation, Signal Level Meter and separate Gain Controls. Includes separate Power Unit.

KIT OF PARTS **£22.0.0** BUILT AND TESTED **£28.0.0** (C. & I. 8/6.)

(13) MULLARD TYPE "C" TAPE PRE-AMPLIFIER.

Suitable for most ½-track Mono Tape Decks. Incorporates Ferroxcube Push Pull Oscillator and 3-speed equalisation. Includes separate Power Unit.

KIT OF PARTS **£14.0.0** BUILT AND TESTED **£19.10.0** (C. & I. 7/6.)

(14) MULLARD TAPE AMPLIFIER Model HF/TR3.

Based on Mullard's type "A" design and suitable for most ½-track Mono Tape Decks. Incorporates Ferroxcube Treble Inductor, Gilson Output Transformer, and 3-speed equalisation. Includes separate Power Unit using PARTRIDGE Mains Transformers.

KIT OF PARTS **£13.13.0** BUILT AND TESTED **£19.0.0** (C. & I. 7/6.)

(15) MULLARD FOUR-CHANNEL MIXING UNIT.

Self-powered Cathode Follower output. Incorporates two inputs for CRYSTAL MICROPHONES, one for CRYSTAL PICK-UPS and a fourth for Radio or Tape.

KIT OF PARTS **£8.8.0** BUILT AND TESTED **£11.10.0** (C. & I. 7/6.)

Alternative Model I/L provides for one input matched for moving coil or ribbon mike **£1/17/-** extra.

THE NEW STERN DOUBLE FEATURE PRE-AMPLIFIER AND JL10 POWER AMPLIFIER

A new conception in the field of audio engineering by Stern-Clyne development engineers. The most up-to-date circuitry is used in the double feature pre-amplifier. It has matched inputs for microphone, crystal or magnetic pick-ups and radio tuner and in addition offers full facilities for tape recording and high fidelity replay. This unique feature means that should you wish to include tape in your hi-fi system at a later date all that is required is a suitable tape deck.

(16) JL10 POWER AMPLIFIER

incorporates the latest triode/pentode ECL86 valves in push-pull, PARTRIDGE ultra linear output transformer, PARTRIDGE mains transformer and smoothing choke. 10 watts power output, surplus power available for tuner. Output impedance 3-7.5-15 ohms.

KIT OF PARTS **£11.11.0** BUILT AND TESTED **£14.14.0** (C. & I. 7/6.)

(17) DOUBLE FEATURE PRE-AMPLIFIER.

Inputs for microphone, crystal or magnetic pick-ups tuner unit, push-button switching for 3 tape speeds equalised. Tape erase Bias Oscillator circuit incorporating ferroxcube transformer. Function switch, separate bass, treble and volume controls, level control and latest EM87 magic-eye level indicator. The pre-amplifier is totally enclosed in a silver hammered finish steel case. An attractive Perspex front panel carefully designed to blend in with modern wood finishes complete the presentation.

KIT OF PARTS **£17.0.0** BUILT AND TESTED **£21.0.0** (C. & I. 5/-.)

Prices if both units purchased together:—

KIT OF PARTS **£27.10.0** BUILT AND TESTED **£33.12.0** (C. & I. 10/-.)

(18) STEREO TAPE DECK WITH BUILT-IN PRE-AMPLIFIER.

A professional addition to your Hi-Fi Stereo System consisting of two basic Units, the Tape Deck and Pre-amplifier, which employs 4 Transistors and 4 Valves. The unit will record and playback ¼-track stereo or ½-track mono at either 7½ i.p.s. or 3¾ i.p.s., both speeds being fully equalised. Features: **Track System:** ½-track 2 channel stereo or monaural record and playback. Independent single channel recording on either channel while playback on other channel. Head Type: ½-track 2 channel in-line stereo and associated erase heads. Low loss laminated pole pieces. **Level Indicators:** 2 Meters, 1 per channel. **Digital Counter:** 3 digit tape position indicator. **Automatic Stop:** When tape runs out or breaks. **Inputs:** Microphone 1 mV (50 K/ohms impedance). Gram/Tuner 50 mV (high impedance). **Output:** (cathode follower). **Monitor Sockets:** 2 × 5 K/ohms impedance. **Audio Output:** 500 mV. **Oscillator:** Push-pull 80 kc/s. **S/N Ratio:**—45 dB or better at 7½in. tape speed. **Separation:** 45 dB or more between stereo channels. **Frequency Response:** 40 to 15,000 cycles per sec. at 7½ i.p.s., 40 to 9,000 cycles at 3¾ i.p.s. **Single Motor:** 4-pole heavy duty induction type. **Power Supply:** 240 v. A.C. 50 cycles. **Size:** 6¾ × 10½ × 15in. **Tape Size:** Up to 7in. **Line-Up:** 4-2SB173 transistors, 2-12AT7, 1-12AU7, 1-12BH7 Valves.

PRICE **42 Gns.** (C. & I. 15/-.)

(19) MODEL CR3/S TAPE RECORDER.

Incorporates the HF/TR3 Mk. II Tape Amplifier (described above) and the Collaro "Studio" Twin Track 3-speed Deck operating at 1⅞in. 3¾in. and 7½in. Complete with Microphone and 1,200ft. Tape.

KIT OF PARTS **£33.8.0** BUILT AND TESTED **£43.0.0** (C. & I. 15/-.)

(20) MODEL HF/G2R PORTABLE TAPE RECORDER.

Incorporates the latest Garrard "Magazine" Tape Deck and Matching Amplifier based on the successful MULLARD TYPE "A" DESIGN and specifically developed to operate the GARRARD DECK. PRICE INCLUDES THE GARRARD TAPE MAGAZINE and 4in. SPOOL OF DOUBLE-PLAY TAPE. A Twin Track Recorder operating at 3¾in./sec. providing up to 1 hour 10 mins. playing time. The outstanding features being excellent performance and simplicity of operation. Incorporates EXT. SPEAKER SOCKET, also operates as independent amplifier for direct reproduction from P.U. Mike or Radio Tuner. Weighs only 22 lb.

(ORIGINAL PRICE £33.) NOW ONLY **22 Gns.** (C. & I. 10/-.)

Microphone 25/- extra.

Model HF/G2R IS ALSO AVAILABLE LESS CABINET AT **19 GNS.** (C. & I. 10/-.)
A complete Tape Recorder Chassis ready for easy fitting into cabinet. Microphone 25/- extra.

HI-FI PORTABLE TAPE PRE-AMPLIFIERS

ready to use incorporating our Type "C" TAPE PRE-AMPLIFIER and choice of Tape Deck in attractive portable carrying case.

(T.11) **COLLARO STUDIO** 3-speed deck **£40**

(T.1) **BRENELL** Mk. 5 Series, Series II, 3-speed deck **£63**

(T.12) **WEARITE** Model 5A deck **£75**

(C. & I. 15/- extra.)

COMBINATION TAPE UNITS

All our Tape Units can be supplied specially matched to any Tape Deck such as Collaro, Brenell Mk. 5 Series II, also the Wearite. Specimen prices as below.

STP-1 Pre-amp. with Collaro Studio Tape Deck.
KIT £36. ASSEMBLED £42.
Assembled with track switch fitted, **£44/2/-.**

STP-1 with Brenell Mk. 5 Series II with Track Switch fitted.
KIT **£68/4/-**

STP-1 with Brenell Mk. 5 Series II ¼-track Deck.
KIT **£74/15/-**

Type "C" Pre-amp. with Collaro Studio Tape Deck.
KIT £24/10/-. ASSEMBLED £30.
Assembled with deck wired and matched **£32/2/-.**

Type "C" Pre-amp. with Brenell Mk. 5 Series II Deck.
KIT £46/11/-. ASSEMBLED £53/1/-.
Assembled with deck wired and matched **£55/3/-**

HF/TR3 with Collaro Studio Tape Deck.
KIT £24/3/-. ASSEMBLED £29/10/-.
Assembled with deck wired and matched **£31/12/-**

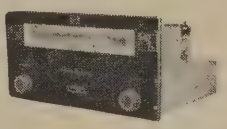
HF/TR3 with Brenell Mk. 5 Series II Deck.
KIT £46/4/-. ASSEMBLED £51/11/-.
Assembled with deck wired and matched **£53/13/-**
Carr. & Ins. 15/- on above units.
Send S.A.E. for comprehensive price list.

PLUG-IN AUDIO MIXER

An extremely versatile two-channel mixer with individual volume controls. Plugs into single high impedance input. Suitable for Tape Recorders, Amplifiers, etc. NO battery required. Two types available: AM3 (as illustrated), phono sockets in and phono plug out. AM5 Standard Jack sockets in and Standard Jack plug out.

ONLY **19/6** P. & P. 1/6.

(21) Mk. II "FIDELITY" F.M. TUNER UNIT



An attractively presented Unit incorporating MULLARD PERMEABILITY TUNING HEART and corresponding Mullard valve line-up. Very suitable to operate with our Mullard amplifiers.

KIT OF PARTS **£10.0.0**
BUILT AND TESTED **£14.5.0**
(C. & I. 5/-.)

TURN OVER FOR MORE STERN-CLYNE PRODUCTS AND ADDRESSES →

Great Britain's Greatest Electronic Hobbies Organisation

5WW—132 FOR FURTHER DETAILS.

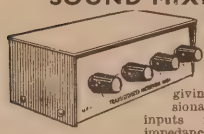
STERN-CLYNE

THE SINCLAIR SLIMLINE

A new 2-TRANSISTOR printed circuit pocket radio. Completely portable—the smallest ever—only 2¾in. × 1¾in. × ¾in. Uses Micro-Alloy Transistors and with built-in ferrite aerial will receive all stations on M.W.—B.B.C.—208, etc. Easy to assemble—no alignment problems. All required components, including earpiece. ONLY **49/6** P. & P. 1/6

All parts sold separately.

TRANSISTORISED SOUND MIXER



Mixing 4 channels from high impedance source, giving professional results, inputs for high impedance Microphone, Tuner, Gram and/or Tape Recorder, 9 v. battery operation. Compact and beautifully styled, size 6in. × 2¼in. × 2¼in. Standard Jack socket inputs. PRICE **59/6**

Complete with PP3 9 v. battery, circuit diagram and instructions. P. & P. 2/6.

THE NEW CHASSIS PUNCH SET

Five of the most used Hole Punches made of the finest hardened steel, will save hours of tedious hand labour, suitable for Aluminium, Sheet Metal, Plastic, etc. Punch sizes ⅛in., 11/64in., ¼in., 11in., 1⅜in., complete with Tommy Bar, Tapered Reamer and Zip Fastening Carrying Case.

PRICE **49/6** P. & P. 3/6.

RECORD PLAYERS

GARRARD Model SRP10 Single Record Player fitted with high output crystal pick-up, £5/9/1.

THE NEW GARRARD "AUTOSLIM" 4-speed Autochanger with crystal pick-up, **£6/10/-**.

GARRARD "AUTOSLIM DE LUXE" 4-speed Autochanger, incorporates transcription Pick-up Arm, **£11/8/-**.

THE COLLARO "C60" 4-speed Autochanger unit with Crystal cartridge, **£6/19/6**.

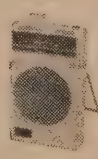
B.S.R. Model UA14, a 4-speed Mixer Autochanger with crystal pick-up, **£5/19/6**.

The new **GARRARD Model 4HF** High Quality Single Record Player fitted with the latest T.P.A. 12 pick-up arm and G.C.S. crystal Cartridge, **£16/17/6**.

PHILIPS Model AG1016. A 4-speed Player which can be operated both manually and automatically. Suitable for Mono or Stereo operation, **£12/12/-**.

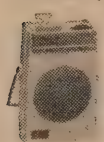
Carriage and insurance on each above 5/- extra.

THE DUVIDAL TWO-WAY TWO TRANSISTOR BATTERY INTERCOM



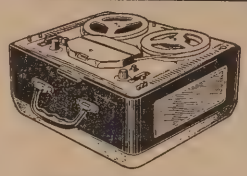
A completely Portable Intercom ideally suitable for the office or as a Baby Alarm—being battery operated it is completely safe. Two-way calling system and volume on/off switch, housed in attractive plastic cabinets with chrome stands. Replacement PP3 Battery costs only 2/6. Complete with battery and 25 yds. lead and plugs. **69/6**

P. & P. 3/6.



AMAZING PURCHASE !

THE FAMOUS "TESLA" FULL FEATURE HIGH QUALITY MAINS PORTABLE TAPE RECORDER Model MTR2



NOW ONLY **22 Gns.** COMPLETE (C. & I. 15/-)

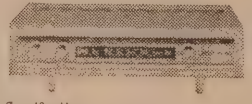
or H.P. Terms £4/14/- DEPOSIT (Plus C. & I.) and 12 monthly payments of £1/13/9. **(ORIGINAL PRICE 42GNS)**

NOW YOU CAN AFFORD A PROFESSIONAL TAPE RECORDER. JUST LOOK AT THESE STAR FEATURES:—

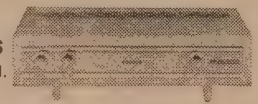
★ Two speeds, 1⅞in. and 3¾in. (fully equalised). ★ Output 4 watts. ★ Twin Track. ★ 7in. × 4in. Elliptical Speaker. ★ Push button controls. ★ Separate tone and volume controls. ★ Takes up to 5in. spools. ★ Frequency response: 1⅞in.—70 to 6,000 c/s; 3¾in.—50 to 12,000 c/s ★ Inputs for Radio, Mike and Pickup. ★ Output sockets for Headphones and Extension Speaker. ★ Instant reset tape positioning indicator. ★ Magic eye record level indicator. ★ Attractive two-tone sturdy case with carrying handle and zipped cover. ★ Size: 13½" × 10" × 7½" ★ A.C. Mains 110/240 v. ★ Absolutely complete with all accessories including Moving Coil Microphone with table stand, full 5in. reel of tape and spare spool, recording lead, spare drive belt, etc.

THE "MIDLAND" TWIN SET

Consisting of F.M. TUNER and matching AMPLIFIER beautifully finished in two-tone beige with chrome knobs, trimmings and feet. Designed to comply with the modern day requirements for shelf mounting equipment.



PRICE **26½ Gns** PLUS C. & I. 10/-.



Specifications:

F.M. TUNER. Frequency coverage 88-108 mc/s. Output 0.7v. Sensitivity 42 db/0.1v. Self powered. Mains supply 200/240v. A.C. Automatic frequency control. Incorporates 1-RF stage, 1-IF stage, 1-Limiter stage and 4 modern miniature valves and 2 diodes.

AMPLIFIER: 4 watts undistorted output Separate Bass and Treble controls. Volume/On/Off control. Inputs for tuner and crystal pickup. Output impedance 4, 8 and 16 ohms. Incorporates 4 modern miniature valves. Dimensions of each unit 3½in. × 12½in. × 7½in.

(Regret these items cannot be supplied separately)

BUILD YOURSELF AN INEXPENSIVE TAPE RECORDER !

LATEST COLLARO STUDIO TAPE TRANSCRIPTOR. Incorporating Record Interlock Lever, 3 motors, 1, 3¾, 7½ i.p.s., takes 7in. spools. Push button controls. **NEW LOW PRICE OF £10/10/- ONLY** plus 7/6 P. & P. Usual H.P. facilities.

NEW TAPE RECORDER AMPLIFIER TYPE 8311-V. Sub-assembled—anyone can build. Printed Circuit, all components mounted and dip soldered. Already tested. Each lead cut to length. All that is required to complete the tape recorder is for a few components to be mounted in the cabinet and the free end of the leads soldered to terminals which are clearly marked, everything supplied, all you need is solder iron, pliers and screwdriver. Valve line-up: 3EF86, ECC83, 2 × EL84, EZ81 and EM34 magic eye. Monitoring facilities, output socket for feeding to high quality amplifier can be used as "straight" amplifier for record reproduction. **EQUALISING ON TWO SPEEDS. OUTSTANDING VALUE AT £11/11/-** plus 2/6 P. & P. including all necessary instructions.

ATTRACTIVE TWO-TONE PORTABLE CARRYING CASE. Suitable for above amplifier and Collaro Studio deck. Fitted 9in. × 5in. High Flux P.M. speaker for high quality reproduction. Inclusive price **£5/5/-** plus 5/- P. & P. Full list of competitively priced mics. and stands on request. The above 3 items purchase at one time **SUPPLIED CARRIAGE PAID.**

NOW AVAILABLE. FOUR-TRACK STUDIO DECK AS ABOVE FITTED WITH HI-FI FOUR TRACK HEADS. PRICE £13/19/6, plus 7/6 P. & P. Four track heads supplied separately, complete with mounting bracket for Studio Deck at 92/6 pair, plus 2/6 P. & P.

TAPE RECORDER AMPLIFIER 8311-4V exactly as 8311-V but four-track, suitable for hi-fi four track heads. **Price £12/12/-.** P. & P. 2/6.

N.B. Four-track deck and amplifier fit the above case without any modification whatsoever.

PRE-AMPLIFIER KIT TYPE 8312-CP. Complete high quality pre-amplifier kit for use with Collaro Studio Deck. **Price £8/8/-,** plus 2/6 P. & P.

HI-FI STEREO HEADPHONES

For the connoisseur who requires perfection. Each Earphone consists of a 2in. Dynamic Loudspeaker with a full frequency range, fitted with foam rubber Ear Pads for added comfort, to keep out noise and to maintain an excellent bass response. The resistance Junction box with change-over switch provides simple transfer from Phones to Speaker. Specifications: **Frequency Range** 25-15,000 c.p.s. **Input Impedance**—16 ohms. **Power Rating**—¼ watt. **Weight**—13 ozs. **PRICE 5 Gns.** P. & P. 2/6. Junction box 15/- extra.

STEREO STETHOSCOPE HEADSETS

Enjoy personal listening in absolute comfort with the new lightweight Stethoscope Headsets suitable for stereo or monaural. Magnetic low impedance. Complete with 6ft. of Cable and Stereo Jack Plug. PRICE **25/-** P. & P 1/6

ACOS MONAURAL STETHOSCOPE HEADSETS

Suitable for Tape Recorders, or monitoring tape recorders, 100 ohm. impedance magnetic. Complete with lead. (Originally 21/-.) OUR PRICE **12/6** P. & P. 1/6

MONAURAL STETHOSCOPE HEADSETS

Suitable for Radio. Tape Recorders, or monitoring tape recordings, magnetic low impedance or Crystal High impedance. Complete with 4ft. of lead and miniature Jack Plug. PRICE **10/6** P. & P. 1/6

THE MINICO JUNIOR TRANSISTORISED TAPE RECORDER

Record anywhere anytime. A truly portable versatile Recorder with a difference, the highly sensitive Crystal Microphone is built into the Zip Carrying Strap which leaves both hands free to operate your Cine Camera, the Microphone can be removed for office use as a Dictating Machine or for Parties. Outstanding quality of reproduction and tone, up to 45 mins. playing time, twin track and operating on 4-1½ volt Half-Pen Batteries. Robust Metal body, size 6½ × 4½ × 2½in. weight 33 oz. Usual price **16 gns.**

OUR PRICE **£6.19.6** P. & P. 4/-.

Complete with Microphone, Tape and Battery.

RECORDING TAPE BARGAINS !

"BEL-CLEER"

FOR THE FIRST TIME IN THIS COUNTRY CANADA'S HI-FI MAGNETIC RECORDING TAPE—MADE BY "BEL-CLEER" OF CANADA.

Following sizes available—others to follow. BRAND NEW—NOT SUB-STANDARD.

High grade acetate base. Attractively boxed fitted leaders, fully guaranteed.

5in. Std. 600ft.	12/6
5in. L.P. 900ft.	15/-
5½in. L.P. 1,200ft.	18/6
7in. Std. 1,200ft.	18/6
7in. L.P. 1,800ft.	25/-

"LAFAYETTE"

AMERICAN RECORDING TAPE. Brand new and boxed. Fully guaranteed.

3¾in. D.P. 600ft. MYLAR	11/6
5in. Std. 600ft. ACETATE	8/6
5in. L.P. 900ft. ACETATE	10/-
5in. D.P. 1,200ft. MYLAR	15/-
5½in. L.P. 1,200ft. ACETATE	12/6
5½in. D.P. 1,800ft. MYLAR	22/6
7in. Std. 1,200ft. MYLAR	12/6
7in. L.P. 1,800ft. ACETATE	15/-
7in. L.P. 1,800ft. MYLAR	20/-
7in. D.P. 2,400ft. MYLAR	25/-

MESSAGE TAPES

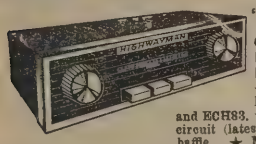
British manufacture. Polythene. 3in. 150ft. 3/6; 3in. 240ft. 5/6; 3in. 300ft. 8/-. P. & P. 6d. per spool, 3 or more post free.

2¼in. 200ft. L.P. TAPE, 5/-.

PLASTIC SPOOL CONTAINERS for spool sizes: 5in. 1/6; 5½in. 2/-; 7in. 2/3.

PLASTIC TAPE SPOOLS. Best quality. 2½in. 1/-; 3in. 1/3; 4in. 2/-; 5in. 2/-; 5½in. 2/3; 7in 2/6. Any single item plus 6d. P. & P. Orders over £1 post free.

NEW LOW PRICES—NOW YOU CAN AFFORD A CAR RADIO!



The "HIGHWAYMAN"

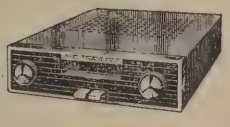
OUR QUALITY CAR RADIO TO BUILD YOURSELF AT A NEW LOW PRICE. Look at these features:—★Attractive styling. ★ Push-pull output. ★ Three latest Mullard transistors plus valve types EBF83 and ECH83. ★ No buzz, high output and sensitivity. ★ Printed circuit (latest type). ★ 7×4in. high flux p.m. speaker and baffle. ★ Medium and Long Waves. ★ Push button for fingertip control. ★ Extremely low battery consumption (less than ¼ amp.). ★ Easy to fit any make car (positive earth only). ★ 12-volt operation. ★ Compact size, measures only 7×7×2¼in. deep. ★ Easy assembly, supplied with dial and drive already mounted.

Special inclusive price of **Only £7.19.6** Plus 5/- P. & P.

All parts available separately. Individually priced parts list and comprehensive instruction booklet 2/6 post free. (Deducted from cost if complete parcel purchased later.)

THE "TRAVLER" MK.II

Introducing our new ready built transistorised car radio for only **9½ Gns.** P. & P. 5/-, including 7 × 4in. speaker fitted to baffle, fixing brackets, filter unit, all nuts and bolts with fitting instructions.



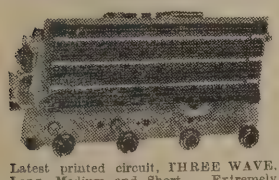
H.P. Terms: £2/19/6 deposit (plus P. & P.) and 7 monthly payments of 22/6.

STAR FEATURES:

★ Handsomely Styled. ★ Mullard Valves and Transistors. ★ Push Buttons. ★ 1½ watts Output. ★ Long and Medium Wavebands. ★ Quality Speaker (E.M.I.). ★ Easily Fitted. ★ Radio Luxembourg (and many other foreign stations). 12-volt Positive Earth Only (applies to 99.8% of cars on the road). ★ Dimensions 7×2×7in. depth.

Optional extras: 3-section chromium plated weatherproof telescopic aerials type 1 17"/44" 19/6. Type 2, 2"/43" 29/6, both plus p. & p. 2/6 if purchased separately.

SPECIAL CHASSIS BARGAIN!

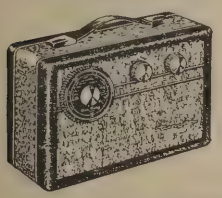


Latest printed circuit, THREE WAVE, Long, Medium and Short. Extremely sensitive, ferrite rod aerial. 4 watts output. Valve line-up: ECL82, EZ80, EBF89, and ECH81. Tape and gram inputs. Tone control. Attractive dial (size 12½×4⅜in.) in maroon with gold lettering. Overall chassis size 12⅜×4⅜×7⅛in. high. A.C. 200/250 v. Fully guaranteed

SPECIAL PRICE £9.19.6

Plus 5/- P. & P. H.P. available.

THE "AIR KING"



Our highly successful six-transistor luxury portable with the "SLIM Line" look. To build yourself, with printed circuit chassis for reliability and simplicity in construction. May be used as car radio, with full M.W. and L.W. coverage. LOOK AT THESE FEATURES:

★ 500 milliwatt output to high flux 7×3½in. high fidelity loudspeaker. ★ Six selected MULLARD TRANSISTORS in latest supersentive circuit plus germanium diode. ★ Compact size only 9½ × 3⅜ × 6¼in. high. ★Attractive three-tone cabinet, black, dark grey, and silver grey with gilt control knobs and all gilt fittings. ★ Co-ax. socket for car aerial. ★ Brand new guaranteed components. ★ Push-pull output. ★ Automatic volume control. ★ Long-life battery. ★ Super-sensitive internal ferrite rod aerial. Special inclusive price for all required components.

ONLY **£7.19.6**

Plus P. & P. 4/-.

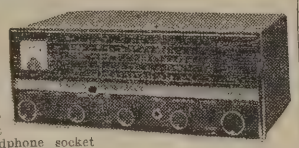
Alignment service available. Full assembly details and individually priced parts list, all of which are available separately. Price 1/6, post free.

WE CAN SUPPLY ALL COMPONENTS TO CONSTRUCT THE

NEWMARKET TRANSISTORISED TRANSFORMERLESS PUSH-PULL 3-WATT AMPLIFIER

as described in December issue. Send S.A.E. for component price list.

THE HE-40 4-BAND COMMUNICATION RECEIVER

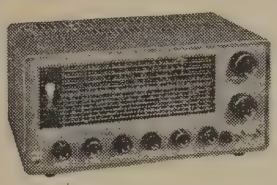


Completely built and ready to go. High sensitivity Superhet receiver covering 550 kc/s-1,600 kc/s, 1.6 Mc/s-4.4 Mc/s., 4.4 Mc/s-11 Mc/s, 11 Mc/s-30 Mc/s. Electrical band-spread tuning. Slide-rule type tuning dial. Internal ferrite rod aerial for Medium wave-band reception and a 59in. 10-section chromium plated telescopic whip aerial for the Short wave bands. Sockets for optional outdoor aerial. Internal monitor loudspeaker. Latest modern miniature B7G bass valves. Headphone socket (may also be used for external loudspeaker). ANL. BFO. Receive/Stand-by switch. Built-in "S" meter 220/240 volt A.C. mains, 50-60 cycle operation. Handsomely styled cabinet with grey crackle finish and handsome front panel, with chrome and satin chrome fittings. Size 13⅜ × 8½ × 5¼in. Wgt. 11¼ lbs. A comprehensive instruction manual is supplied. An ideal receiver for the radio amateur and Short wave listeners of all ages. Send S.A.E. for leaflet.

£24.15.0

CARRIAGE PAID

THE HE-30 4-BAND COMMUNICATION RECEIVER



One of the finest general coverage bandspread Receivers available at this price. Covering 550 kc/s-1,600 kc/s, 4.8 Mc/s-14.5 Mc/s, 1.6 Mc/s-4.8 Mc/s, 10.5 Mc/s-30 Mc/s. Illuminated slide rule dial calibrated every 5 kc/s on 80 and 40 metres. Edgewise S-meter, 0-100 logging scale coverage from 0.55-30 Mc/s. 8 valve plus Rectifier Superhet circuit, RF stage with an Aerial Trimmer. 2 IF stages. BFO control. Q-multiplier. Controls: Function Switch, Audio (Gain, Selectivity (Q-multiplier), Frequency (BFO), Band Selector, IF gain, Trimmer, AVC-MCV Switch, ANL Switch, Main Tuning, Band-spread Tuning and Headphone Jack, Selectivity—60 dB at 10 kc/s, 0.8 kc/s at 6 dB (with Q-Multiplier), IF—455 kc/s, External P.M. Speaker reqd. 4 or 8 ohms impedance. Output 1.5 watts. 8 modern Miniature B7G Bass Valves and 5Y3 Rectifier. Size 15 × 10 × 7⅜in. Grey crackle finish. For operation on A.C. mains 220/240 v. 50/60 cycles.

Full instructions and circuit diagram supplied.

Send S.A.E. for leaflet.

PRICE **40 Gns.**

CARRIAGE PAID

VISIT YOUR NEAREST STERN-CLYNE BRANCH

LONDON:

18, Tottenham Ct. Rd., W.1. MUSeum 5929/0095. Half-day Sat.
23, Tottenham Ct. Rd., W.1. MUSeum 3451/2. Half-day Thurs.
309, Edgware Road, W.2. PADdington 6963. Half-day Thurs.
109, Fleet Street, E.C.4. FLEet St. 5812/3. Half-day Saturday.
162, Holloway Road, N.7. NORth 8161/5. Half-day Thursday.
9, Camberwell Church St., S.E.5. RODney 2875. Half-day Thurs.

CROYDON:

12, Suffolk House, George St. MUNicipal 3250. Half-day Weds.

BRISTOL:

26, Merchant Street, Bristol, 1. Bristol 20261. Half-day Weds.

MANCHESTER:

10, Withy Grove, Manchester, 4. BLAck Friars 5379. Now open 6 days a week.

MAIL ORDERS AND ENQUIRIES TO:

Dept. W.W., 162, Holloway Road, London, N.7. NORth 8161/5.

MULTI-METER BARGAINS

MODEL TK20A

Size 3¾ × 2¾ × 1¾in. Meter size 2¾ × 1¾in. Sensitivity 1,000 o.p.v. on both A.C. and D.C.! A.C. and D.C. volts 0/15, 0/150, 0/1,000 volts D.C. current 0/150 mA. Resistance 0/100K. Complete with test prods, battery and full instructions. OUTSTANDING VALUE AT ONLY **39/6** Plus 1/6 P. & P.

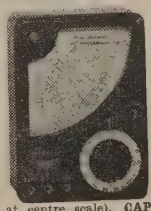
MODEL TK50

Size 5 × 3¾ × 1¾in. 1,000 ohms per volt. D.C. current: 1-250 mA D.C. and A.C. volts 10,250, 500 and 1,000 v. Resistance: 0-10K, 0-100K. Complete with test prods, battery and full instructions. Outstanding buy at

57/6

Plus 2/6 P. & P.

MODEL 200H 20,000 OPV



RANGES: A.C. VOLTS: 10, 50, 100, 500 and 1,000 volts (10,000 o.p.v.). D.C. VOLTS: 5-25, 50, 250, 500 and 2.5K (20,000 o.p.v.). D.C. CURRENT: 0-50 mA, 0.25 mA, 0-250 mA. RESISTANCE: 0-6k, 0-6 meg. (300 ohms and 30 k at centre scale). CAPACITANCE: 10 pf to .001 mfd, .001 mfd to .1 mfd. DECIBELS: −20 to +22 dB. A fully guaranteed pocket size meter, knife edge pointer top quality, supplied complete with test prods and full operating instructions at **£5.5.0** ONLY Post free.

Actual size 4½ × 3⅜ × 1in.

MODEL 500

30,000 OHMS PER VOLT. 9-range D.C. voltage to 1 kV, 7 ranges A.C. voltage to 1 kV. 5 ranges D.C. current to 12 amp., 3 ranges resistance to 60 meg. Incorporating internal buzzer for audible warning of direct shorts and blocking condensers for A.F. output. Capacity −20, +56. Measurements 3 $\frac{5}{16}$ × 6 $\frac{5}{16}$ × 2⅜in. Outstanding value at

£8.19.6 H.P. available.

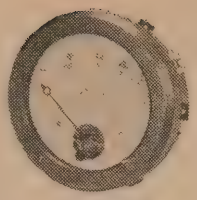
LEATHER CARRYING CASE for Model 500. Price 30/- only.

ALSO SEE PAGES 90, 91 and 92 FOR MORE STERN-CLYNE PRODUCTS

Great Britain's Greatest Electronic Hobbies Organisation

WW—134 FOR FURTHER DETAILS.

FERRANTI VOLTMETERS N5.
0-300 volts, 25-100 c/s. Moving iron. 6in. scale. Fl. mtd. Hermetically sealed, grade IN. Made 1955. BRAND NEW. Boxed **79/6.** Post 4/-.



INDUSTRIAL METER. Iron clad. 0 to 300 v. A.C. 50 cycles. Moving iron, 6in. scale Fl. mtg. BRAND NEW. **59/6.** P. 4/-.

MILLIAMMETERS
Panel meter 0-1 milliamp. Flush mounting circular. Barrel diameter 2½in., outside diameter 3½in. Dials are scaled 0-100. Resistance is 75 ohms. Fe & NFe. BRAND NEW. **25/-.** P. & P. 1/-.
Meter Rectifiers (S.E.I.). 1 mA. **8/6.**
Westinghouse 5 mA. **7/6.**

MICROAMMETERS
R.C.A. 0-500 microamps. 2¼in. circular flush panel mounting. Dials are engraved 0–15, 0–600 volts. As used in the American version of the No. 19 set. **15/-.**

AR-88 SPARES
Escutcheons (Windows). **8/6.**
Knobs. Medium size. Set of 8, **15/-.**
Block Condenser (3 x 4 mfd.), **15/-.**

CONSTANT VOLTAGE TRANSFORMERS. Input 190 to 260 volts. 50 c.p.s. Output 115 volts at 2 kVA. A pair of these will give a constant output of 230 volts at 4 kVA. Price **£15** each, plus £1 carriage. Two for **£30.** Carriage paid.

HEAVY DUTY BLOWERS
For 200-250 v. A.C./D.C. mains, 300 watts. With 1½ inch diam. twin "V" shape outlets. 2 lengths of hose, 4 spare filters and brushes. Suitable for industrial use, forges, etc. Brand new. **£4/19/6.** Carr. 10/6.

MULLARD CRYSTAL CALIBRATOR. In neat grey metal case 9 x 7 x 6½in. Gives 1 Mc/s. 100 Kc/s and 10 Kc/s marker pips and harmonics, as selected. Optional 400 c/s modulation. Complete with five 1T4 and 1R5 valves and 1 Mc/s, B7G glas crystal. Requires 60 v. H.T. and 1.5 v. L.T. In original transit case. **BRAND NEW. £4/19/6.** Carr. 7/6.

COSSOR DOUBLE BEAM OSCILLOSCOPE TYPE 1035
A modern oscilloscope in good working order. Fully guaranteed. **£37/10/-.** Carr. 30/-.
SPARE TUBES for this 'scope. Type 89D. BRAND NEW. **59/6.** P. & P. 4/6.

AVO WIDE RANGE SIGNAL GENERATORS
Six turret operated ranges covering 50 Kc/s. to 80 Mc/s. For use on standard A.C. mains. Packed in original transit cases with accessories. Post-war type in new condition. **£15.** Carriage 10/-.

MARCONI SIGNAL GENERATOR TF-517. Three ranges. 18 to 58 Mc/s in 2 individually calibrated ranges and 160 to 300 Mc/s by indirectly calibrated dial. A.C. mains operation. **AS NEW CONDITION** in original transit cases with instruction book. **£7/10/-.** Carr. £1.

STANDARD TRANSFORMERS
Vacuum impregnated, interleaved, E.S. screen, universal mounting. Size 4 x 3½ x 2½in. ALL BRAND NEW. **18/6** each. Post 2/6.
Type 1. 250-0-250 v. 80 m/a., 6.3 v. 3 a. tapped at 4 v. 4 a., 6.3 v. 1 a., tapped at 4. v. and 5 v. 2 a.
Type 2. As above, but 350-0-350 v. 80 m/a.
Type 3. 30 v. 2 a., tapped at 12, 15, 20 and 24 v., to give 3-4-5-6-8-9-10 v., etc.
Type 5. 0-6-9-15 v. 4 a. Ideal for chargers.

CANADIAN CRYSTAL CALIBRATOR
As used in Wireless Set No. 52. Gives marker pips at 1 Mc/s. 100 Kc/s and 10 Kc/s intervals. Harmonics are available up to 30 Mc/s. Incorporates a twin 1 Mc/s/100 Kc/s crystal and uses a multivibrator circuit for 10 Kc/s. Requires 12 v. L.T. and 150 v. H.T. Complete with valves, circuit of 52 set and operational notes. **BRAND NEW. 37/6** plus 2/6 post.

PRECISION WIRE WOUND RESISTORS
Manufactured by ALMA, RIVLIN, etc. Values available 200Ω, 1K, 2.5K, 5K, 10K, 25K, 50K, 100K, 250K, 500K, 1MΩ. 1%—**1/3**, 0.1%—**2/-**, 0.05%—**2/6.** Please add post.

WESTON PORTABLE WATTMETER
Dynamometer type. Model 432. Accuracy 1%. 4in. mirror scale. For use on D.C. or A.C. (25 to 1,000 cycles). Ranges 0-350, 700 and 1,400 watts. Max. volts 400. A high quality precision instrument. **BRAND NEW. £9/19/6.** P.P.

L, C & R BRIDGES
AVO. Capacity 5 pfd. to 50 mfd. Resistance 5 ohms to 50 Megohms. Inductance can be measured against external standard. Balance is indicated on a meter which can be used as a valve voltmeter from 0.1 to 15 v. Leakage test and Power Factor scale. A.C. mains operation. Tested and guaranteed and in superlative condition. **£9/10/-**, plus 5/- P. & P.

AR-88 SPARE VALVES. Complete set of BRAND NEW individually boxed original valves (14). **£2/10/-.** P. & P. 2/6.
AR-88 VIBRATOR PACKS. For 6 v. operation. Complete with vibrator and OZ4 rectifier. BRAND NEW in original cartons. **17/6.** P. & P. 2/6.

MAGNETIC COUNTERS (Ex-G.P.O.). 4 figures to 9,999. Coils 500Ω for 24 v. operation. Tested. (No reset.) **5/-** each. P. & P. 1/6. SPECIAL OFFER. 10 for **30/-.** P. & P. 5/-.

RELAYS G.E.C. MINIATURE SEALED

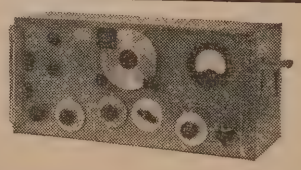
M–1095.	670 2M 2B H/D Wire Ends	7/6
M–1099.	670Ω 2M H/D Wire Ends	7/6
M–1052.	5,000Ω 2/CO. Plat Wire Ends	10/–
M–1493.	670Ω 4/CO. Plat	12/6

ALL BRAND NEW and BOXED. Please add postage.

UNISELECTORS
25 positions, 8 bank double wipers, 50 volt operation. Ex-equipment and tested. **45/-.** Post 2/6.

ELECTRONIC FREQUENCY CONVERTER CV-253/ALR. Ex U.S.A. equipment of recent design (1956). Covers 38 to 1,000 Mc/s in four switched bands as follows: 38 to 130, 130 to 300, 300 to 550 and 550 to 1,000 Mc/s. Can be directly used with the APR-4 search receiver or, if a power supply is provided, into any 30 Mc/s receiver or IF strip. Directly equivalent to all three tuning heads as used in the APR-4. **BRAND NEW. £45.**

PCR COMMUNICATION RECEIVERS
All sets are in PERFECT WORKING ORDER and give very fine results on short waves. PCR-2 **£5.19/6**, PCR-3 **£8/8/-. CARRIAGE** (any type), **10/6.** S.A.E. for details.
POWER SUPPLIES. The above receivers require 250 volts HT and 12 volts LT. We will supply any of the above receivers fitted with a **BRAND NEW INTERNAL POWER SUPPLY** for **£2** extra. Fully guaranteed ready for use on A.C. mains.



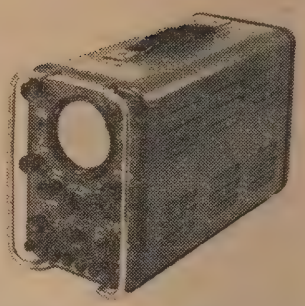
STANDARD SIGNAL GENERATOR. MARCONI TF-144G/4 **£16.10.0** Carr. 30/-
Complete and in apparently very good condition but sold as received from the Air Ministry, i.e., untested and less leads. Technical manual and circuit supplied. We assure potential customers that "untested" does NOT mean "beyond economical repair" but are willing to supply GUARANTEED WORKING instruments complete with leads, etc., for **£25.**

HEATHKIT & JASON AGENTS.

CHARLES BRITAIN (Radio) LTD.

11 UPPER SAINT MARTIN'S LANE
LONDON W.C.2. *TEMple Bar 0545*
Near Leicester Sq. Station. (Opposite Thorn House)
Shop hours: 9-6 p.m. (9-1 p.m. Thursdays). Open all day Saturday

5WW—135 FOR FURTHER DETAILS.



PORTABLE OSCILLOSCOPE CT84. A compact general purpose instrument with many unusual features. Size 9in. high, 8in. wide, 16½in. deep. Time base 10 c/s. to 40 Kc/s. Y plate sensitivity 40V per cm. Tube 2¾in. Frequency compensated amplifier up to 38 dB gain. Bandwidth up to 1 Mc/s. Single sweep facilities. As supplied the instrument operates from 24 v. D.C. Despatched in metal transit case. As new condition. Tested and guaranteed. **£16/10/-.** Carr. 7/6.

ADVANCE SIGNAL GENERATOR. Type L1. A first grade laboratory type instrument covering 300 to 1,000 Mc/s. Directly calibrated dial. Direct reading attenuator. A.C. mains operation. Pulse and sine wave modulation (variable pulse width). Original price £375. As new. **£120.**

MUIRHEAD TWO-PHASE LOW FREQUENCY DECADE OSCILLATOR. D-880-B. (Rack Mounting). Frequency range 0.01 c/s to 11.2 Kc/s, continuous in five ranges. Twin outputs at 0° (600Ω) and 90° (10KΩ) are simultaneously available. Unused and guaranteed. **£125.**

TS-175 HETERODYNE FREQUENCY METER
A high frequency version of the well-known BC-221. Accuracy 0.05%. Frequency range 80 to 1,000 Mc/s. As new condition with original calibration book. Tested and guaranteed. **£75.**

LM-14 HETERODYNE FREQUENCY METER
Naval version of the BC-221. 125 Kc/s to 20 Mc/s. Undoubtedly superior to the BC-221 in construction and performance. Requires 12 or 24 v. LT and between 200 and 475 v. HT (self stabilised). A particularly useful feature is variable RF coupling and modulation is also available. With correct individual calibration books. Unused and guaranteed. **£25.** P. & P. 7/6. Separate power unit for A.C. (if required). **£4/10/-.** P. & P. 5/-.

SIGNAL GENERATOR CT-53
A precision instrument covering 8.9 to 15.5 Mc/s and 20 to 300 Mc/s in six ranges. Variable attenuator from 1μV to 100 millivolts. AC mains operation. Good condition tested and complete with calibration chart. **£16/10/-.** Carr. 10/-.

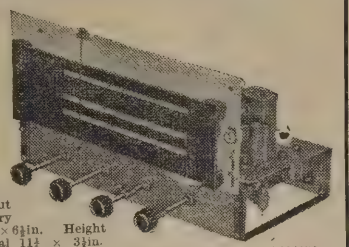
MOVING COIL PHONES. Finest quality Canadian with chamois ear-muffs and leather-covered headband. With lead and jack plug. Noise excluding and supremely comfortable. **22/6.** Post 1/6.

HEWLETT PACKARD 205 AG. An American audio signal generator of the finest quality. Ranges 20 to 200, 200 to 2,000, and 2,000 to 20,000 c.p.s. Output is 5 watts. Fully variable attenuator 0 to 110 db in 1 db steps. Output impedances 50, 200, 500 and 5,000 ohms CT ungrounded. Input and output monitor meters. Operation from 110 volts A.C. mains. Electrically perfect but wooden cases may be slightly damaged. **£30.** Carr. 30/-.

HEAVY DUTY L.T. TRANSFORMERS. (Gresham.) Latest type potted, oil filled. Pri. 230 v. 50 c/s. Sec. 0–70–75–80 v. 4 amps. Size 5½ x 4½ x 6½in. high. Wt. 19 lb. BRAND NEW. **32/6.** Carr. 5/-.

7 VALVE AM/FM RADIOGRAM CHASSIS

Valve line-up ECC85, ECH81, EF89, EABC80, EL84, EM81, EZ80.



Three Waveband and Switched Gram positions. Med. 200-550 m. Long 1,000-2,000 m. VHF/FM 88-95 Mc/s. Philips Continental Tuning insert with permeability tuning on FM and combined AM/FM IF transformers. 460 Kc/s. and 10.7 Mc/s. Dust core tuning all coils. Latest circuitry including AVC and Neg. Feedback. Three watt output Sensitivity and reproduction of a very high standard. Chassis size 13½ × 6½in. 7½in. Edge illuminated glass dial 11½ × 3½in. Height Vertical pointer Horizontal station names. Gold on brown background. A.C. 200/250 v operation. Magic-eye tuning. Cct. diag. now available.

Aligned and tested ready for use **£13 . 10 . 0** *Carr. & Ins. 5/-*

Complete with 4 Knobs—walnut or ivory to choice. Indoor FM aerial **3/6** extra. 3 ohm P.M. Speaker only required. Recommended Quality Speakers 10in. Elac H/D, **30/-**. 13½in. × 8in. E.M.I. Fidelity, **35/-**. 12in. R.A. with cone Tweeter, **42/6**. Carr. 2/6.

CO-AX 80 ohm CABLE

High grade low loss Cellular Air Spaced Polythene—¼in. diam. Stranded Cond.

Now only 6d. yard.

BARGAIN PRICES—SPECIAL LENGTHS
20 yds. **9/-**; P. & P. 1/6. Coax. Plugs **1/-**.
40 yds. **17/3**. P. & P. 2/-. Sockets **1/-**.
60 yds. **25/-**. P. & P. 3/-. Couplers **1/3**.

VALVES

NEW BOXED		ALL GUARANTEED	
IT4	3/6	ECL82	10/-
IR5, 1S5	6/-	ECL80	9/-
3S4, 3V4	7/-	EF80	7/6
DAF96, DF96, DK96, DL96	8/-	EF86	8/6
		EL84	7/-
		EY51	9/-
		EY86	9/-
ECC81, ECC82, ECC83	7/-	EZ81	7/-
		GZ32	9/6
		PCC884	8/-
		PCF80	8/-
		PCL83	10/6
		PCL84	9/-
		PL81	9/6
		PL82	9/-
		PL83	8/-
		PY32	10/6
		PY81	8/-
		PY82	7/-
		U25	10/6

TRIMMERS. Ceramic (Compression Type)—30 pF., 50 pF., 70 pF., **9d.**; 100 pF., 150 pF., **1/3**; 250 pF., **1/6**; 600 pF. **1/9**.

PHILIPS Bee Hive Type (conc. air spaced)—2-8 pF. **1/-**; 3-30 pF. **1/-**.

METAL RECTIFIERS-STC. Types—RM1 **4/9**; RM2 **5/6**; RM3 **7/6**; RM4 **16/-**; RM5 **21/-**; RM4B **17/6**.

JACK PLUGS—2½in. Igranic type **2/6**; Screened ditto **3/3**; 1½in. Screened **2/3**; Transistor type Min. & Sub-min. **1/3**.

JACK SOCKETS—Moulded Igranic type, open **3/6**, ditto, closed **4/-**. Pax. type open **2/6**, ditto. closed **3/-**. Transistor type closed, Min. & Sub.-min. **1/6**.

EAR PLUG PHONES—Min. Continental type 3ft. lead, jack plug and socket. High Imp. **8/-**. Low Imp. **7/6**.

WAVECHANGE SWITCHES. 1 p. 12-way, 2 p. 2-way, 2 p. 6-way, 3 p. 4-way, 4 p. 2-way, 4 p. 3-way, long spindle, **3/6** ea.

STYLUS REPLACEMENTS. Diamond Styli for L.P. or Stereo, for all pop. types, BSR, Collaro, Garrard, etc., **11/3** ea. Ctd. 12 mths. SAPPHIRE ditto, **5/3** ea. Comp. range in stock.

BARGAIN CORNER

Brand New. Mfrs. surplus 1st grade 1 OC44 & 2 OC45, **15/6**. 1 OC81D & 20C81, **15/6**. All above and OA81, **32/6** post free.

¼ Meg. VOL Controls D.P. Sw. ¼in. flatted spindle. Famous Mfrs. **4 for 10/-** post free.

TRANSISTOR COMPONENTS

Midget I.F's—465 Kc/s ⅜in. diam. **5/6**
Osc. Coil M/W ⅜in. dia. **5/3**
Osc. Coil M & L.W. **5/9**
Midget Driver Trans. 3.5 : 1 **6/9**
Midget Output Trans. Push Pull—3 ohms **6/9**

Elec. Condensers—Midget Type 1 mfd. 50 mfd. ea. **1/9**, 100 mfd. **2/-**. 12 v. wkg.

Condensers 150 v. working: .01 mfd. .02 mfd., .03 mfd., .04 mfd. **9d.**, .05 mfd., .1 mfd. **1/-**, .25 mfd. **1/3**; .5 mfd. **1/6**, etc.

Midget Tuning Condensers J.B. "OO" 208 pf. and 176 pf. **8/6**; ditto with trimmers **9/6**. JB 220pf. and 105 pf. conc. slow motion **10/6**. 365 pf. single **7/6**. Sub Min. ¾in. Dilemin 100 pf., 300 pf., 500 pf. **7/-** each.

FERRITE AERIALS. M. & L.W., car aerial coil **9/3**.

Midget Vol Control with edge control knob. 5 K/ohms, with switch, **4/9**. Ditto less switch **3/9**.

Speakers: P.M.; 2in. Plessey 75 ohms **15/6**. 2½in. Continental 8 ohms **13/6**. 7 × 4in. Plessey 35 ohms **23/6**. 2½in. Continental 8 ohms **13/6**.

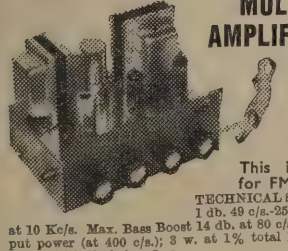
TRANSISTOR BARGAINS

Brand New—BVA 1st Grade			
OC44	8/6	OC70	5/6
OC45	8/-	OC71	6/-
OC81	7/6	GEX34	2/9
GET114	6/6	OA70	2/9
OC72	7/6	OA81	2/9
AF117	9/6	OA79	2/9

BARGAINS 4-SPEED PLAYER UNITS

Single Players	carr. 3/6
E.M.I. Stereo/Mono...	£5 10 0
B.S.R. Lates: Mod. TU12	£3 12 6
E.M.I. Junior "985"...	£3 7 6
Auto-Changers	carr. 5/-
Garrard "Auto-Slim"	£6 19 6
B.S.R. (UA 16).....	£6 19 6
B.S.R. (UA14).....	£6 10 0

MULLARD "3-3" HI-FI AMPLIFIER. 3 VALVES 3 WATT



3 ohm and 15 ohm Output. A really first-class Amplifier giving H-iFi quality at a reasonable cost. Mullard's latest circuit. Valve line up: EF86, EL84, EZ81. Extra HT and LT available for Tuner Unit addition. This is the ideal companion Amplifier for FM tuner units.

TECHNICAL SPECIFICATION—Freq. Response: + or — 1 db. 49 c/s.-25 Kc/s. Tone controls: Max. Treble Cit. 12 db. at 10 Kc/s. Max. Bass Boost 14 db. at 80 c/s. Sensitivity: 100 Mv for 3 w. output. Output power (at 400 c/s.); 3 w. at 1% total harmonic distortion. Hum and Noise Level. At least 70 db. below 3 w.

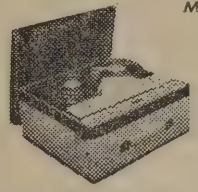
COMPLETE KIT (incl. valves, all components wiring diagram and special quality sectional Output Trans.).

BGN. PRICE £8/19/6. Carr. 4/6.
Complete wired and tested, **8 gns.** Wired power O/P socket and additional smoothing for Tuner Unit, **10/6** extra.

Bronze Escutcheon Panel, Printed Vol. Treble, Bass, On-Off, supplied with each Kit.

Recommended Speakers—WB, HF 1012 **87/6**. Goodmans AXIOM 10 **£6/5/-**. 8in. AXIETTE **£5/5/-**, or AUI 10M 51, **£8/10/-**.

ANOTHER TAPE RECORDER BARGAIN



Mfrs.' end of production Surplus Offer

A 24 gns. Tape Recorder offered at the bargain price of only **15 gns.** plus 10/- carr. Supplied in 3 Units already wired and tested. A modern Circuit for quality recording from Mike Gram or Radio, using latest B.S.R. Twin Track Monardeck Type TD2.
Valve line-up—EF86, ECL82, EM84, EZ80 and Silicon Diode. Send for detailed list—3d. stamp.

Completed Kit comprising items below.

BARGAIN PRICE 15 Gns. + 10/- Carr.

2-tone Cabinet and 8in. × 5in. Speaker. Size 14in. × 10½in. × 7½in.	£3 10 0 + 5/- Carr.
Wired Amplifier complete with 4 Valves, front Panel, Knobs, etc.	£5 12 6 + 3/6 Carr.
B.S.R. Monardeck Type TD2	£7 7 0 + 4/6 Carr.
Accessories: Mike, Tape, empty Reel, screened Lead and Plugs, Instructions, etc.	£1 0 0 + 2/- Carr.

We manufacture all types Radio Mains, Transf. chokes, Quality O/P Trans., etc. Enquiries invited for specials, prototypes for small production runs. Quotation by return.

RECORDING TAPE

Famous American Columbia (CBS) Premier quality tape at NEW REDUCED PRICES. A genuine recommended Quality Tape—TRY IT! Brand new, boxed and fully guaranteed. Fitted with leader and stop foils.

Standard		Double Play	
5in. 600ft. ..	13/-	1,200ft...	31/6
5½in. 900ft...	16/-	1,800ft...	37/6
7in. 1,200ft..	21/-	2,400ft...	47/6

Long Play Post & Pack. per reel, 1/- plus 6d. ea. for additional reels.

SPECIAL OFFER. 3in. Message tape, 150ft. **3/9**; 3in. L.P. 225ft. **4/9**; 3in. D.P. 300ft. **6/6**; P. & P. per reel 6d.
TAPE REELS. Mnfrs. surplus 7in. **2/3**; 5½in. **2/-**; 5in. **2/-**; 3in. **1/3**; Plastic spool containers, 5in. **1/9**; 5½in. **2/-**; 7in. **2/3**.

SPEAKERS P.M. 3 ohms. 2½in. EMI, **15/6**. 3in. Goodmans **16/6**. 5in. Rola **15/6**. 6in. Elac **16/6**. 7in. × 4in. Goodmans **15/6**. 8in. Rola **19/6**. 10in. Elac **25/-**. 10in. × 6in. Goodmans **22/6**. 2½in. E.M.I. Tweeter, **22/6**. 13½in. × 8in. E.M.I. **35/-**.

ENAMELLED COPPER WIRE—¼lb. reels 14g-20g. **2/6**; 22g-28g. **3/-**; 30g.-34g. **3/9**; 30g-38g. **4/3**; 39g-40g. **4/6** etc.

TINNED COPPER WIRE 16-22g., **2/6** ¼lb.
VALVE HOLDERS—Int. Oct. **6d.** Nylon or Ceramic, B7G, B9A unskirted, **9d.** B7G B9A skirted **1/-** each; B7G with Can **1/6**; B9A with Can, **1/9** etc.

KNOBS—Modern Continental types: Brown or Ivory with Gold Ring. 1in. dia. **9d.** each, 1¼in. **1/-** each, Brown or Ivory with Gold Centre 1in. dia., **10d.** each; 1¼in. **1/3** each.
LARGE SELECTION AVAILABLE.

TYGAN FRET (Contem. pat.), 12 × 12in **2/-**. 12 × 18in. **3/-**; 12 × 24in. **4/-**, etc. **BONDACOUST Speaker Cabinet Acoustic Wadding**, 12in. wide, any length cut **1/6** ft. **4/-** yd. **EXPANDED ANODIZED METAL** Attractive gilt finish ¼in. × ¼in. diamond mesh **4/6** sq. ft. Multiples of 6in. cut. Max. size 4ft. × 3ft. **47/6** plus carr.

JASON F.M. TUNER UNITS
Designer-approved kits available.
FMT1. 5 gns., 4 valves **20/-**.
FMT2. 27. 5 valves **35/-**.
JTV Mercury. 10 gns. 3 valves **22/6**
JTV2. £13/19/6. 4 valves **28/6**
NEW JASON F.M. HANDBOOK 2/6
48 hr. Alignment Services, 7/6 plus 2/6

CONDENSERS—Silver Mica. **All values 2 pf. to 1,000 pf., 6d. each. Ditto ceramics 9d. Tub. 450 v. T.C.C., etc. .001 mfd., .01 and .1/350 v. 9d. .02-1/500 v., 1/-. .25 Hunts 1/6. .5 T.C.C. 1/9 etc., etc.**
CLOSE TOL. S/MICAS, 10% 5 pf.-500 pf. **8d.** 600-5,000 pf. **1/-** 1% 2 pf.-100 pf. **9d.** 100 pf.-500 pf. **11d.** 575 pf.-5,000 pf. **1/6.**

RESISTORS—Modern ratings full range 10 ohms to 10 megohms. 20% ½-½ w. **3d.** ea., ditto 1 w. **6d.** ea., 2 v. **9d.** ea., 10% ½-½ w. **4d.** ea., 5% Hi-stab, ½-½ w. **6d.** ea. (below 100 ohms and over 1 meg. **9d.** ea.). 1% Hi-stab, ½ w. **1/6** ea., (below 100 ohms **2/-** ea.). **WIREWOUND.** 25 ohms to 10K. 5 w. **1/3** 10 w. **1/6**, 15 w. **2/-**.

PRE-SET T/V POTS. W/W 25 ohms-50 K. **3/-**. 50 K-2 Meg. (Carbon), **3/-**.

Electrolytics All Types New Stock

TUBULAR		CAN TYPES	
25/25v. 50/12v.	1/9	8 + 8/450 v.	4/6
50/50v. 100/25v.	2/-	32 + 32/275 v.	4/6
8/450v. 4/350v.	2/3	50 + 50/350 v.	6/6
16 60/450 v.	5/6	60 + 250/275v.	17/6
32/32/450 v.	6/6	100 + 300/275v	12/6

Transistor Midge types—all values 1 mfd. to 50 mfd. 1/9 ea., 100 mfd. 2/-, 12 v.

VOLUME CONTROLS—5K —2 Meg. ohms. 3in. SPINDLES, MORGANITE MIDGET TYPE. 1¼in. dia. Guar. 1 year. LOG or LIN. ratios, less Sw. **3/-** D.P. Sw. **4/6**. Twin Stereo less Sw. **6/6**. Some values with DP Sw. **8/6**.

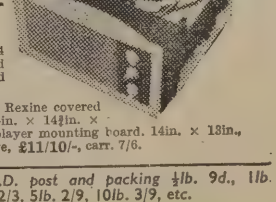
DE-LUXE RECORD PLAYER KIT

Incorporating 4 Sp. Garrard Auto-Slim unit and Mullard latest 3 w. amplifier (ECL 86 and EZ 80), vol., bass and treble controls, with 8in. × 5in. 10,000 line speaker.

Contemporary styled two-tone cabinet, charcoal grey and off-white with matching blue relief. Size 17½in. × 16in. × 8in. **£13.19.6**

COMPLETE KIT. Carr. and ins. 10s..
Cat. & Const. details **2/6** (free with kit)

STANDARD RECORD PLAYER KIT



using BSR UA14 unit. Ready-wired amplifier and 7in. × 4in. quality speaker and O/P trans. **£3/19/6.** Carr. 2/6.

BSR UA14 unit £6/10/0. Carr. & ins. 5/-. Rexine covered cabinet in 2-tone maroon and cream size 16½in. × 14½in. × 8½in. with all accessories plus uncut record player mounting board. 14in. × 13in., **59/6**, carr. and ins. 5/-. **Complete Kit, as above, £11/10/-**, carr. 7/6.

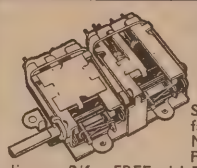
Only a few items are listed from our comprehensive stock. Write now for full bargain lists, 3d.

Terms: C.W.O. or C.O.D. post and packing ½lb. 9d., 1lb. 1/3, 3lb. 2/3, 5lb. 2/9, 10lb. 3/9, etc.

TRS RADIO COMPONENT SPECIALISTS *Established 1946*

70 BRIGSTOCK RD., THORNTON HEATH, SURREY
Tel. THO 2188: Hours 9 a.m.—6 p.m. 1 p.m. Wednesday

BARGAINS TO SEE FROM R & TV



A.M./F.M. PERMEABILITY TUNER FOR ALL TRANSISTOR OPERATION.

Size 2½in. x 2½in. approx. By famous manufacturer. A.M.-I.F. 470 Kc/s. F.M.-I.F. 10.7 Mc/s. A.M coverage from 1,620 Kc/s.-525 Kc/s. F.M. coverage 108 Mc/s-88 Mc/s. Circuit diagram 2/6. FREE with Tuner 25/-. 1st, 2nd, 3rd A.M.-I.F.'s 12/6 set. 1st, 2nd, 3rd and 4th F.M.-I.F.'s 12/6 set. V.H.F. Osc. choke 1/-. A.M.-I.F. trap 1/6. A.F. 114 and A.F. 115 5/- each. All the above are the R.F. end of an AM/FM receiver car radio etc. The above six items purchased together **£2 . 10 . 0**

BSR MONARCH UA14 With FUL-FI HEAD

4-speed, plays 10 records, 12in., 10in. or 7in. at 16, 33, 45 or 78 r.p.m. Intermixes 7in., 10in. and 12in. records of the same speed. Has manual play position: colour, brown. Dimensions: 12½ x 10¾in. Space required above baseboard 4¾in., below baseboard 2¾in. Fitted with Ful-Fi turnover crystal head, **£5/19/6.** P. & P... 6/6.
B.S.R. UA16, similar to the above, **£6/12/6.** P. & P. 6/6.
B.S.R. GU7, 4-speed, single-player, complete with pick-up on uni-plate with automatic switch. **£3/19/6.** P. & P. 5/6.

4 VALVE AMPLIFIER *Ideal for small halls*

High power—high quality 200/250 v. A.C. 2 inputs, mike and gram., bass and treble lifts. For use with Standard/L.P. records. Two would be suitable for stereophonic. Ideal P.A. system, **£3/19/6.** P. & P. 7/6.

CRYSTAL MIKE to suit, **15/-.** P. & P. 2/-. 8in. x 5in. **P.M. SPEAKER** to suit, **12/6.** P. & P. 2/-.

STAAR 45 9 v. BATTERY RECORD PLAYER

COMPLETE WITH PICK-UP AND DECK

For a completely portable record player. Head is protected by a plastic dome with a brush which cleans the stylus as it rises into playing position. 45 r.p.m. Automatic on/off switch, governed 9 v. motor. Attractive 2-tone grey finish. **£2/9/6.** P. & P. 2/6.

POCKET MULTI-METER. Size 3⅞ x 2⅛ x 1⅜in. Meter size 2⅛ x 1⅜in. Sensitivity 1,000 O.P.V. on both A.C. and D.C. A.C. and D.C. volts 0-15, 0-150, 0-1,000. D.C. current 0-150 mA. Resistance 0-100KΩ. Complete with test prods, battery and full instructions. **35/-.** Plus 1/6 P. & P.

SIGNAL GENERATOR

Covering 100 Kc/s.-100 Mc/s. on fundamental and 100 Mc/s. to 200 Mc/s. on harmonics. Metal case 10in. x 6¾in. x 5¼in., grey hammer finish. Incorporating three miniature valves and metal rectifier. A.C. mains 200/250 v. Internal Modulation of 400 c.p.s. to a depth of 30%. Modulated or unmodulated R.F. output continuously variable 100 millivolts C.W. and mod. switch, variable A.F. output. Incorporating magic-eye as output indicator. Accuracy plus or minus 2%.

£7/5/0 Post and Packing 6/6 extra.

LINE E.H.T. TRANSFORMER

With built-in line and width control. 14 kv. Scan Coil, 90in. deflection, on ferrite yokes. Frame O.P. transformer 500 pf., 18 kv. smoothing condenser. Can be used for 14in., 17in. or 21in. tubes. Complete with circuit diagram, **29/6.** Plus 5/- P. & P.

MAINS TRANSFORMERS

ALL WITH TAPPED PRIMARIES 200/250 VOLTS

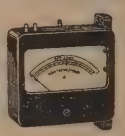
250-0-250 v. 60 mA., 6.3 v. 1.5 amp., 6.3 v. 1 amp.	11/6
250-0-250 v. 80 mA., 6.3 v. 1.5 amp., 6.3 v. 1 amp.	15/-
250-0-250 v. 50 mA., 6.3 v. 2 amp.	9/6
250-0-250 v. 250 mA., 6.3 v. 5 amp.	19/6
Heater Transformer 6.3 v. c.t. 3 amp.	7/6

Postage and packing on all the above transformers 4/-.

Primary 230-240 v., Secondary 330-0-330 v. 200 mA. 6.3 v. c.t. 6 amp., 5 v. 4 amp. 21/-. P. & P 6/-.

ALTITUDE METER 180 degrees scale. 3in. diameter. Would make ideal car-rev.-counter. **£1 +2/-** postage and pkg.

50 MICRO-AMP METER movement by world-famous manufacturer. Size 3in. x 2⅜in. **25/- + 1/-.**



PRESS-BUTTON COIL PACK. Medium and 2 shorts. Complete with twin-gang tuning condenser and ferrite rod aerial. **19/6,** plus 2/6 P. & P. Circuit diagram 2/6. FREE with pack.

SPECIAL OFFER!

OBTAINABLE ONLY FROM R. & T.V.

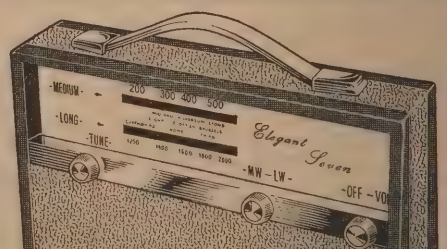
THE *"Elegant Seven"*

COMBINED PORTABLE & CAR RADIO

THE RADIO WITH THE "STAR" FEATURES

- ★ 7-transistor superhet. Output 350 mW.
- ★ Two-tone grey wooden cabinet, fitted handle with silver-coloured fittings. Size 12½in. × 8½in. × 3½in.
- ★ Horizontal tuning scale, size 11½in. × 2⅜in. in silver with black lettering.
- ★ All stations clearly marked.
- ★ Ferrite-rod internal aerial.
- ★ IF 470 kc/s.
- ★ Operated from PP9 battery.
- ★ Fully comprehensive instructions and point-to-point wiring diagram.
- ★ Printed circuit board, back-printed with all component values.
- ★ Fully tunable over medium and long waveband.
- ★ Car-aerial socket.
- ★ Full after-sale service.

Parts list and circuit diagram 2/6. FREE with parts. 4½" speaker also available 7/6 extra.



ONLY £5.9.6

PLUS 5/6 POSTAGE AND PACKING

RADIO AND T.V. COMPONENTS (ACTON) LTD.

21A, ACTON HIGH ST., LONDON, W.3. ● *Goods not despatched outside U.K. All enquiries S.A.E. Terms C.W.O.*

SHOP HOURS 9 a.m.—6 p.m. EARLY CLOSING WEDNESDAY.

5WW—137 FOR FURTHER DETAILS.

15 amp. Thermostat

Adjustable over a fairly wide range of temperatures but set for 70° F. suitable for wall mounting to control room heaters. Exceptional bargain at **9/6**, plus 1/- post and insurance.

Beginners' Superhet

As supplied to many schools and colleges. A simple basic superhet — easy to understand and which can be progressively extended — ideal for students — components include: valves, metal rectifier, tuning condenser, I.F. transformers, etc. In fact complete superhet except speaker. Price **£3** plus 3/- post and insurance. Data included free or sep. 1/6.

Infra-Red Heater

Make up one of these latest type heaters, ideal for bathroom, kitchen, bedroom, etc. They are simple to make from our easy to follow instructions—uses silica enclosed elements designed for the correct infra-red wavelength (3 microns). Price for 750 watt element and metal casing as illustrated **19/6** plus 2/6 post and insurance.

Waterproof heater wire. 16 yd. length. 70 watts. Self regulating temperature control, **10/-** post free.

Morganite Potentiometers

Single and 2-gang types available, standard size with good length spindle, all new. Single types **1/-** each, values available: 5K, 25K, 50K, 100K, 250K, 1 meg.,2 meg. Gang type **3/-** each-values available 5K + 5K, 100K + 100K, 1 meg. + 1 meg.

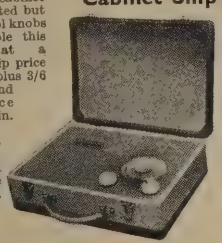
Copper Clad Element

Mount this under a reflector to make ideal infra red heater, also suitable for building into convector, Blower Heater, drier cabinet, etc., etc., 230/40 v. 1250 watts 12in. long, but can be bent to almost any shape, **7/6** each plus packing and insurance 2/6 extra.

Meter Bargains

2in. Moving Coil 500 micro amp. f.s.d. Brand new **17/6** plus 1/- packing and insurance.

Cabinet Snip



This fine cabinet as illustrated but less control knobs is available this month at a special snip price of **12/6**, plus 3/6 post and insurance Size is 3½in. × 9in. × 4in. and it is nicely covered in two tone I. C. I. fabric.

Yaxley Switches

1 pole, 2 way	2/-;	1 pole, 3 way	2/-
1 pole, 4 way	2/3;	1 pole, 5 way	2/6
1 pole, 7 way	3/-;	1 pole, 9 way	3/-
1 pole, 11 way	3/-;	1 pole, 12 way	3/3
2 pole, 2 way	2/3;	2 pole, 4 way	2/6
2 pole, 5 way	5/-;	2 pole, 6 way	3/6
2 pole, 12 way	5/6;	3 pole, 3 way	3/-
3 pole, 6 way	4/-;	3 pole, 12 way	8/6
4 pole, 2 way	3/-;	4 pole, 3 way	3/6
4 pole, 4 way	3/6;	4 pole, 5 way	6/6
4 pole, 6 way	6/6;	4 pole, 11 way	10/6
4 pole, 12 way	11/6;	5 pole, 3 way	4/6
5 pole, 6 way	8/-;	5 pole, 12 way	14/6
6 pole, 6 way	9/6;	6 pole, 3 way	4/6
6 pole, 12 way	17/6;	6 pole, 11 way	16/6
6 pole, 4 way	6/6;	8 pole, 2 way	6/6
8 pole, 4 way	7/6;	8 pole, 6 way	11/6
8 pole, 12 way	23/6;	12 pole, 2 way	8/-
12 pole, 5 way	16/6;	12 way fader	3/6

1 pole, 6 way incremental shorting 3/6

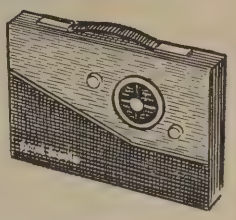
Please add 1/- to cover post and packing on all orders below £3.

CABINET & PICK-UP

Made for a famous company intending to make a battery Record Player but changing their minds. This is an extremely fine looking cabinet, must have cost at least £2 to make. It is complete with handle and fasteners as illustrated. Also included in the parcel is a Cosmocord pick-up with crystal cartridge and sapphire stylus. Both items new and perfect.

ONLY 19/6 Plus 4/6 post and insurance.

GOOD COMPANION Mark III



The 6-transistor set with the 8-transistor performance.

Incorporating all the latest refinements. Anyone who can solder can make it.

Many thousands already in use all over the country.

Full coverage of Long and Medium wavebands.

Fine looking cabinet, size 11 × 8 × 3in. Q.P.P. output approx. 750 MW.

Excellent reception of difficult stations like 208.

Variable feed back gives excellent tone. **ONLY £5/19/6** plus 4/- post.

THIS MONTH'S SNIPS

FLUORESCENT LIGHTING FITTINGS

All complete and ready to work as soon as tubes are fitted. Unused and guaranteed in perfect working order.

THE TWIN 20 (Plug-in model)

This very popular fitting is two feet long and approx. five inches wide. This makes it ideal for Corridors, hall ways, kitchens, Toilets, etc. Being plug-in it can be quickly changed from room to room as desired, light output approx. same as 100 watt lamp. White enamel. Brand new and perfect. Uses standard tubes. **19/6** plus 3/6 post and insurance.

THE TWIN 20 (Batten model)

Similar to above but intended for mounting directly to ceiling or hanging by chains. **18/6** plus 3/6 Post.

THE FOUR FOOT 40

A white enamelled batten type fitting, extremely popular as a kitchen light but equally suitable for bedroom or office, etc. Complete ready to work when standard bi-pin tube is fitted. **14/6** plus 4/6 carr. and insurance.

THE FIVE FOOT 80

Similar to above but for 5 foot 80 watt tube. **27/6** plus 7/6 carr. and insurance.

CIRCLE-LITE (plug-in model)

Straight fittings may look a little plain in some positions but the circular types are just as efficient and have the very modern look. They are ideal in living rooms, shops and offices, in fact anywhere and being plug-in they can be fitted in a jiffy, at no extra expense. Whole shops and offices can be re-lit in minutes and at something like three times the light quantity for the same current is achieved; additional wiring is not necessary to create a tremendous light increase. 40 watt circular fitting. Complete, requiring only tube. **19/6** plus 2/6 post and packing.

CIRCLE-LITE (surface mounting)

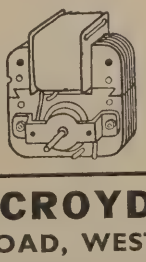
As above but intended for direct to the ceiling. **27/6** plus 3/6 post and packing.

NOTE: Tubes are available to callers from **7/6** each but can only be dispatched in minimum quantities of 6 owing to damage risk.

MULTI-METER BARGAIN

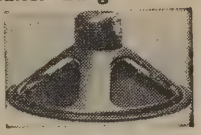
Model number EP10K. Extra wide scale fitted corner-wise for compactness, extra accurate as it uses 1% components. Sensitivity 10,000 ohms per volt. A.C. and D.C. ranges. D.C. voltage up to 1.2kV in 5 ranges. A.C. voltage up to 1.2kV 5 ranges. D.C. current up to 300mA 3 ranges. Resistance up to 2 meg. Capacities 0.05 to .15 mfd and decibels. Complete with full instructions and test prods and battery for ohms range. A real bargain not repeatable once stocks cleared. Price **69/6**. Carriage and insurance 5/-.

MOTOR BARGAIN



Silent running mains motor by very famous maker. Ideal for gramophone, tape recorder, fan, etc., etc. 200-250 volts. A.C. shaded pull start. Size approximately 2¾ × 2¼ × 1¾in. 2,750 r.p.m. Spindle diameter 5/32in. Spindle length ¾in. Brand new guarantee. Price **12/6** plus 1/- post.

Speaker Bargain



12in. High fidelity loudspeaker. High flux permanent magnet type with standard 3 ohm speech coil. Will handle up to 12 watts. Brand new, by famous maker. Price **27/6** plus 3/6 post and insurance.

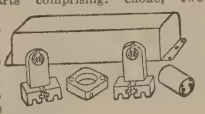
Timer Kit

Special offer of all components except metal box to make mains operated interval timer for photography, etc., **12/6** plus 2/6 post.

5000 mfd Condensers

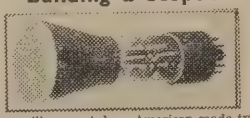
12v. working—Plessey—perfect **2/-** each, 18/- dozen.

Fluorescent Light Bargain



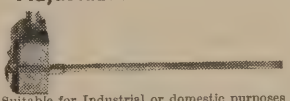
Kit of parts comprising: choke, two lamp holders, starter holder and starter, 40 watt **19/6**. 80 watt, **27/6**. Plus 2/6 post and insurance.

Building a Scope?



3in. oscilloscope tube. American made type No. 3FP7, base 6.3 v. 6 amp. heater electrostatic deflection, brand new and guaranteed, with circuit diagram of scope, **15/-** each plus 2/6 post and insurance.

Adjustable Thermostat



Suitable for Industrial or domestic purposes such as controlling furnace oven, immersion heater, etc. Can also be used as a flamestat or fire alarm. Made by Sunvic these are approximately 17in. long and adjustable over a range 0 to 550°F. The contacts are rated at 15 amps. 230 volts, and the adjustment spindle, which comes to the top, can be fitted with a flexible drive for remote control or just a pointer knob for local control. Listed at **£3** or **£4** each, these are offered only at **8/6** plus 2/6 postage and insurance.

Electric Blanket Spares

We carry a good stock of elements, thermostats and switches, etc., for Electric Blankets. Send S.A.E. for list.

Ice-Stat

This is a small thermostat which cuts on and off at around freezing point. Has many uses, one of which could be an ice warning device to be fitted under your motor car. Price **7/6**. Post 1/-.

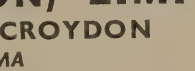
Simmerstat Heater Regulator

Suitable to control elements, heaters, soldering irons and boiling rings up to 2,500 watts. Complete adjustable, normal price 55/- each, special snip price **12/6**, plus 1/6 postage and insurance.

Refrigerator Thermostat

Standard type with adjustment for all normal refrigerator temperatures, **7/6**, 1/- post.

Suppressor Condenser



Stop your drill or other appliances interfering with your own or your neighbours' radio or television. Simple instructions given. **1/6** each. **12/-** dozen.

ELECTRONICS (CROYDON) LIMITED

266 LONDON ROAD, WEST CROYDON

OPPOSITE SAVOY CINEMA

5WW—138 FOR FURTHER DETAILS.

RADIO CLEARANCE LTD.

TRADE ENQUIRIES INVITED

27 TOTTENHAM COURT RD., LONDON, W.1
The oldest Component Specialists in the Trade.

Telephone: MUSEUM 9188
EST. 35 YRS.

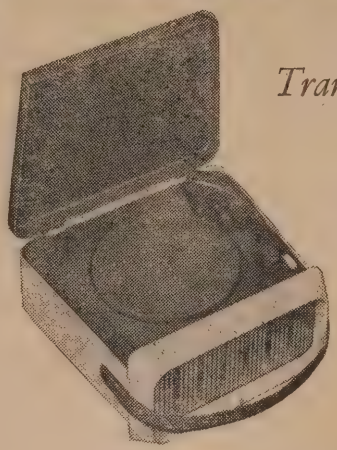
ANOTHER SCOOP — LIMITED QUANTITY ONLY

DON'T MISS A CHANCE LIKE THIS!

FEATURES:

- ★ Ready-built amplifier with 4 first grade Mullard transistors
- ★ Plays 45 r.p.m. Pop records
- ★ Built-in automatic stop
- ★ Lightweight and portable
- ★ Instruction leaflet supplied
- ★ Crystal pickup with expendable stylus GP59
- ★ Operates from a 9 v. battery (3/9 extra)
- ★ Available in two colours, cream/red or cream/blue

A.—Motor and pickup deck, 39/6. (2/6 P&P.)
B.—Ready-built 4-Transistor Amplifier, complete with Volume Control and Loudspeaker. 35/-, (2/- P.P.)
C.—Portable two-tone case with handle, 5/-. (2/6 P.P.)



The "Minigram" Transistorised Record Player

- ★ Approximate dimension 9" × 8½" × 4"
- ★ A real "Family Favourite"
- ★ Ideal for Teenagers
- ★ For use ANYWHERE
- ★ Hours of amusement for the
- ★ younger members of the family
- ★ Assemble one of these amazing Players in less than 30 mins., supplied in 3 complete units with only 10 connections to make

ONLY 79/6 *The complete PACKAGE* (Plus 5/- P.P.)

OR ANY UNIT SOLD SEPARATELY

BARGAINS STILL AVAILABLE IN LOUDSPEAKERS

Enormous purchases of Brand New and guaranteed Plessey loudspeakers enable us to offer these units at THE LOWEST PRICES EVER.
Don't miss this golden opportunity to obtain a first-grade permanent magnet LOUDSPEAKER off the production line at LESS THAN MANUFACTURERS' COST.
Read carefully the prepared list below and choose just the right speaker for the job—COMPARE THE PRICES ANYWHERE

SCHEDULE OF LOUDSPEAKERS AVAILABLE

Diameter in inches	Gauss in Lines	Impedance in Ohms	Price	Diameter in inches	Gauss in Lines	Impedance in Ohms	Price	Diameter in inches	Gauss in Lines	Impedance in Ohms	Price
2	7,000	80	8/-	4	6,000	35	10/6	5	8,500	3	9/6
2½	7,000	35	8/6	4	7,000	35	11/-	5	9,500	3	10/6
2½	7,000	50	8/6	4	9,500	35	11/6	5	9,500	5	10/6
2½	7,000	80	8/-	5	6,000	3	8/-	5	10,000	3	11/6
3½	8,500(E.M.I.)	3	8/6	5	6,000	5	8/-	6½	7,000	3	11/-
3½	7,000	35	8/6	5	7,000	3	9/6	6½	7,000	5	11/-
3½	9,500	50	10/6	5	7,000	5	8/6	6½	8,500	3	11/6
4	7,000	25	11/6	5	7,500	8	9/-				

Elliptical Size in Ins.	Gauss in Lines	Impedance in Ohms	Price	Elliptical Size in Ins.	Gauss in Lines	Impedance in Ohms	Price	Elliptical Size in Ins.	Gauss in Lines	Impedance in Ohms	Price
5×3	6,000	3	7/6	5×3	9,000	25	11/-	8×2½	6,000	3	8/6
5×3	7,000	3	8/	6×4	8,500	3	9/6	8×2½	7,000	5	9/-
5×3	9,000	3	8/6	6×4	9,500	3	10/-	8×2½	8,500	5	9/6
5×3	9,000	4	8/6	7×3½	9,500	8	10/6	8×2½	9,500	8	10/-
5×3	6,000	25	9/6	7×4	7,000	8	10/-	8×2½	9,500	4	10/-
5×3	7,000	25	10/-								

ALLOW 2/- each speaker for P.P. handling charges, and please specify the exact requirements—the nearest available will be sent.

OVER 50,000 SOLD AND STILL THE DEMAND CONTINUES FOR OUR "HEAVENLY TWINS"

Ask for a demonstration in the shop

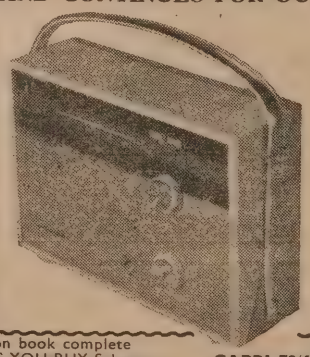
"CAPRI"

Sensitive !
Super-Selective !
Superb Speaker !

NOW ONLY **79/6** (2/- P. & P.)

Pocket superhet MW and Droitwich. Size: 4½in. x 2¾in. x 1¼in.
Constructional data 1/9 Post free.

The best and easiest transistor build-yourself sets available—send S.A.E. for free Parts List.
6 first-grade Mullard Transistors, Diodes, and all components brand new and guaranteed.



CHOICE OF A DOZEN STATIONS IN DAYLIGHT!

THE "CONTESSA"

Queen of them all!

ONLY

£9 . 19 . 6

(3/6 P. & P.)
Portable and car radio.
2 waveband Superhet.
Constructional Book, 2/10 Post free.

Inclusive price for all associated components, case, and instruction book complete in every detail. Any parts SOLD SEPARATELY on the BUILD-AS-YOU-BUY Scheme.

CONTESSA £9/19/6 (plus 3/6 P.P.). CAPRI 79/6 (plus 2/- P.P.). Battery 2/6 extra.

SELECTED BARGAINS

Beautifully geared AM/FM 2 Gang Condensers 4/6; AM/FM 1FT's 465 kc/s and 10.7 Mc/s. 4/6 pair; Magnavox Crystal Tape Recorder Mikes 12/6; Double-Tuned Transistor, ferrox 1FT's Q120, 470 kc/s. 5/6 pair; Plessey-Brayhead turret tuners, 34/38 Mc/s., valved 8/6 each; 3 watt Stereo Amplifiers complete ready to switch on, 79/6; Sentercell rectifiers R3/2D; D3-2-1Y, 2/6 each. DIODES—OA70, OA79, OA90, CG46H, GD10 2/- each. TRANSISTORS: Set of 6 (R.F. and L.F.) including 1 watt matched pair, heat sink and diode, 13/6 the set; OC45 4/6; PNA 101 3/9; AF115 4/6. SUBMIN GERMANIUM DIODES 1/3. M.I. DIODES: 6d. each. Silicon Diodes 200 PIV-200 mA. 1/- each; 400 PIV 330 mA. 2/6 each. Transistor Submin 7 m.m. coil set (4) 4/- per set.
Please send STAMPED AND ADDRESSED envelope with any enquiry. We regret no catalogues—our stocks move too quickly! Kindly make provision for sufficient postage and packing charges to avoid delay. TERMS: Cash with order or C.O.D. on orders over 10/-.

R.S.T. VALVE MAIL ORDER CO.

211a STREATHAM ROAD, MITCHAM, SURREY

Tel: MITcham 6202 **Open Daily to Callers**

All Valves Brand New and Fully Guaranteed — Obsolete valves a speciality.
Quotations given on any type not listed. Send S.A.E.

Special 24 Hour Express Mail Order Service

AC2/PEN 19/6	ECC85 ... 7/6	EY81 ..... 8/6	PCC84 ... 7/-	U10 ..... 9/-	UY21 ...15/6	6AL5 ..... 4/-	6P28 .....12/6	12Q7GT... 6/6
AC2/PEN DD 19/6	ECC88 ...12/6	EY83 .....12/6	PCC85 ... 9/6	U12 ..... 9/-	UY41 ... 7/6	6AM5 ... 5/-	6Q7 ..... 9/6	12SA7..... 8/6
AC/TP ...29/-	ECC91 ... 3/-	EY86 ..... 7/-	PCC88 ...12/6	U14 ..... 9/-	UY85 ... 6/6	6AM6 ... 4/-	6Q7G ... 6/6	12SJ7 ..... 8/-
AC/VP1-5-7 15/-	ECF80 ... 7/6	EY91 ..... 3/-	PCC89 ... 8/6	U22 ..... 8/-	VM24B ...12/6	6AQ5 ... 6/6	6Q7GT ... 8/6	12SK7..... 6/-
AZ1 .....15/-	ECF82 ... 8/6	EZ35 ..... 6/-	PCF80 ... 8/-	U24 .....21/-	VMP4G ...15/-	6AT6 ..... 6/-	6SA7 ..... 7/-	12SL7 ... 8/-
AZ31 .....13/6	ECH3 ...21/6	EZ40 ..... 7/-	PCF82 ... 7/-	U25 .....11/-	VP4 .....15/-	6AU6 ... 9/-	6SC7 ..... 8/6	12SN7 ...10/-
B36..... 9/-	ECH21 ...21/-	EZ41 ..... 7/-	PCF84 ...12/6	U26 .....10/-	VP4A 15/-	6B8G 3/-	6SF5 .....10/-	12SQ7 ...12/-
CIC 10/-	ECH35 ...10/-	EZ80 ..... 6/-	PCF86 ...12/6	U31 ..... 9/-	VP4B 15/-	6BA6 ..... 6/-	6SG7 ..... 7/-	14H7 .....10/-
CCH35 ...20/-	ECH42 ... 9/6	EZ81 ..... 6/-	PCL82 ... 8/-	U35 .....17/6	VR105/30 7/-	6BE6 ..... 6/-	6SH7 ..... 6/-	14R7 .....10/-
CL33 .....12/6	ECH81 ... 7/6	EZ90 ..... 4/6	PCL83 ...10/-	U37 .....17/6	VR150/30 7/-	6BG6G ...15/-	6SJ7 ..... 6/6	19AQ5 ... 8/-
CY1 .....15/-	ECH83 ... 8/6	E1148 ... 2/-	PCL84 ... 7/-	U47 .....11/-	W61 .....11/-	6BJ6 ..... 6/-	6SK7 ..... 5/6	19BG6G...15/-
CY31 .....12/6	ECL80 ... 7/6	FC2 .....15/-	PCL85 ... 9/-	U50 ..... 7/-	W76 ..... 5/-	6BQ7A ...12/6	6SL7GT ... 6/-	20D1 .....10/-
D77 ..... 4/-	ECL81 ...10/-	FC2A ...17/6	PCL86 ...12/6	U52 ..... 4/-	W77 ..... 4/-	6BR7 .....10/6	6SN7GT... 5/6	20D2 .....21/-
DAC32 ... 9/6	ECL82 ... 9/6	FC4 .....15/-	PENA4 ...19/6	U76 ..... 7/6	W81 ..... 6/-	6BS7 .....12/6	6SN2GT... 5/6	20F2 .....17/6
DAF91 ... 5/6	ECL83 ...10/6	FW4/500 9/-	PEN4DD 22/6	U78 ..... 4/6	W81M ... 6/-	6BW6 ... 8/-	6SQ7 ..... 8/6	20L1 .....22/6
DAF96 ... 7/6	ECL86 ... 9/6	FW4/800 9/-	PEN4VA 17/6	U145 .....10/6	X41 .....22/6	6BW7 ... 8/-	6U4GT ...12/6	20P1 .....15/-
DCC90 ...12/6	EF6 .....21/-	GZ30 ...10/6	PEN36C 20/-	U191 .....13/6	X61M.....10/-	6C4 ..... 3/6	6U5G ... 7/6	20P3 .....24/-
DF33 ..... 9/6	EF9 .....21/-	GZ32 ...10/6	PEN45 ...10/-	U251 .....15/-	X65 .....12/6	6C5GT ... 8/-	6V6G 4/6	20P4 .....20/-
DF91 ..... 4/-	EF22 .....14/-	GZ33 ...19/3	PEN45DD 21/-	U281 .....15/-	X76 .....12/6	6C6 ..... 6/6	6V6GT ... 8/-	20P5 .....20/-
DF92 ..... 7/-	EF36 ..... 4/-	GZ34 ...13/6	PEN46 ... 5/-	U282 .....19/6	X76M.....12/6	6C9 .....12/6	6X4 ..... 4/6	25A6 ..... 8/-
DF96 ..... 7/6	EF37 ..... 8/-	GZ37 ...19/3	PEN453DD 20/-	U301 .....18/6	X78 .....26/-	6CD6G ...27/6	6X5G ... 6/-	25L6 ..... 8/-
DH63 ... 6/-	EF37A ... 8/-	HABC80 10/-	PENDD4020 20/-	U329 .....15/-	X79 .....40/-	6CH6 ...10/-	6X5GT ... 8/6	25Y5 ..... 8/-
DH77 ... 7/-	EF39 ..... 4/-	HL41 ..... 8/-	PL33 .....15/-	U339 .....13/6	Y61.....10/-	6CW4 ...16/-	6/30L2 ...12/6	25Y5G ... 8/-
DK32 .....11/-	EF40 .....15/-	HL41DD 8/6	PL36 .....12/6	U403 .....10/-	Y63.....10/-	6D2 ..... 4/-	7B5 ..... 12/6	25Z4 ..... 7/6
DK91 ..... 6/-	EF41 ..... 8/-	HL92 ..... 8/6	PL38 .....21/-	U404 .....10/-	Z63..... 7/6	6D6 ..... 5/6	7B7 ..... 8/6	25Z5 ..... 8/-
DK92 ..... 7/6	EF42 .....10/-	HL133DD 9/6	PL81 ..... 8/6	U801 .....19/6	Z66.....10/-	6E5 .....10/-	7C5 ..... 8/6	25Z6 ..... 8/6
DK96 ..... 7/6	EF50A ... 3/6	HN309 ...25/-	PL82 ..... 8/-	UABC80 7/-	Z77..... 4/-	6F1 .....10/6	7C6 ..... 8/6	27SU 19/6
DL33 ..... 8/6	EF50E ... 3/-	IW4/350 10/-	PL83 ..... 7/6	UAF42 ... 8/6	Z152 ..... 5/-	6F6 ..... 6/9	7D5 .....15/-	30C1 ..... 9/-
DL35 .....10/-	EF80 ..... 5/-	IW4/500 10/-	PL84 ..... 8/-	UB41 ..... 7/6	OZ4 ..... 5/-	6F12 ..... 4/-	7D6 .....15/-	30C15.....12/6
DL91 ..... 8/-	EF85 ..... 5/-	KT33C ... 8/-	PL820 ...18/-	UBC41 ... 8/6	IA7 .....11/-	6F13 .....10/-	7D8 .....15/-	30F5 .....10/-
DL92 ..... 6/-	EF86 ..... 8/-	KT36 .....17/6	PM24M ...13/6	UBC81 ...10/-	IC5 .....10/-	6F14 .....10/-	7H7 ..... 6/-	30FL1 ...10/6
DL93 ..... 7/-	EF89 ..... 9/-	KT61 ..... 9/6	PX4 .....15/-	UBF80 ... 8/-	ID5 ..... 8/6	6F15 .....12/6	7R7.....12/6	30L1 ..... 8/6
DL94 ..... 7/6	EF91 ..... 4/-	KT66 .....15/-	PX25 .....25/-	UBF89 ... 7/6	ID6 .....10/-	6F19 .....12/6	7S7.....17/6	30L15 ...11/-
DL96 ..... 7/6	EF92 ..... 4/-	KT76 .....10/-	PY31 .....15/-	UBL21 ...20/-	IH5 ..... 9/6	6F23 .....10/6	7Y4..... 6/6	30P4 .....18/-
EA50 ..... 2/-	EF95 ..... 5/-	KT81 ..... 8/-	PY32 .....12/6	UCC84 ...11/6	IL4 ..... 5/-	6F25 .....16/6	8D3 ..... 4/-	30P12 ...10/-
EABC80... 5/6	EF98 .....10/-	KTW61 ... 8/-	PY33 .....10/6	UCC85 ... 7/6	IN5..... 9/6	6F26 .....13/6	9BW6 ...12/6	30P16 ... 9/-
EAC91 ... 4/-	EF183 ...10/6	L63 ..... 5/-	PY80 ..... 7/6	UCF80 ...12/6	IR5 ..... 6/-	6F33 ..... 5/6	10C1 .....12/6	30P19 ...17/6
EAF42 ... 9/6	EF184 ...10/6	LN152 ... 8/-	PY81 ..... 7/6	UCH21 ...20/-	IS4 ..... 8/-	6H6 ..... 2/-	10C2 .....17/6	30PL1.....15/-
EB34 ..... 2/6	EK32 ..... 8/6	LN309 ...11/6	PY82 ..... 6/9	UCH42 ... 8/6	IS5 ..... 5/6	6J5 ..... 5/6	10F1 .....10/-	30PL13 ...12/6
EB41 ..... 5/-	EL3 .....21/6	LZ319 ...12/6	PY83 ..... 8/-	UCH81 ... 8/-	IT4 ..... 4/-	6J5G 4/6	10F9 .....12/6	30PL14 ...16/6
EB91 ..... 4/-	EL32 ..... 4/6	MKT4 ...17/6	PY88 .....10/-	UCL82 ... 9/6	IU5 ..... 5/9	6J5GT ... 5/-	10LD11 ...15/-	35A5 .....15/-
EBC3 ...21/-	EL33 .....10/-	MS4B 17/6	PY800 ...10/-	UCL83 ...13/6	2P 22/6	6J7 ..... 7/6	10P13 ...15/-	35L6GT ... 8/6
EBC33 ... 4/6	EL34 .....14/-	MVS/PEN 17/6	PZ30 .....15/-	UF41 ..... 7/6	3A4 ..... 5/-	6J7G 5/-	10P14 ...19/-	35W4..... 7/6
EBC41 ... 8/6	EL35 .....10/-	MVS/PENB 17/6	QS95/10 10/-	UF42 ..... 7/6	3A5 .....10/6	6J7GT ... 7/6	11D5 .....23/6	35Z3 .....15/-
EBC81 ...10/-	EL37 .....17/6	MU14 ... 9/-	QS150/15 10/-	UF80 ..... 7/-	3Q4 ..... 8/-	6K7 ..... 7/6	12A6 ..... 6/6	35Z4 ..... 7/6
EBF80 ... 8/-	EL38 .....17/6	MX40 ...15/-	R2 .....10/-	UF85 ..... 7/6	3Q5 ..... 9/-	6K7G ... 2/-	12AH8 ...10/-	35Z5 ..... 8/6
EBF83 ... 8/-	EL41 ..... 9/6	N18 ..... 8/-	R16.....17/6	UF86 .....12/6	3S4 ..... 6/-	6K7GT ... 7/6	12AT6 ... 7/6	41STH ... 22/6
EBF89 ... 8/-	EL42 ..... 9/6	N37 .....14/-	R19.....16/-	UF89 ..... 6/6	3V4..... 7/6	6K8 ..... 9/6	12AT7 ... 5/-	42 .....12/6
EBL1 .....21/-	EL81 .....12/6	N78 .....26/-	R20.....16/-	UL41 ..... 8/-	5U4 ..... 4/-	6K8G ... 5/-	12AU6 ...17/6	50C5 .....10/-
EBL21 ...21/-	EL84 ..... 6/9	N108 .....26/-	SP41 ..... 3/6	UL44 .....20/-	5V4G 7/9	6K8GT ... 9/6	12AU7 ... 5/-	50CD6G 30/-
ECC35 ... 8/-	EL85 .....10/-	N308 .....18/-	SP61 ..... 3/6	UL46 .....14/6	5Y3G 5/6	6K25 .....17/6	12AX7 ... 5/-	50L6 ..... 8/6
ECC40 ...15/-	EL90 ..... 8/6	N339 .....30/-	T41 .....15/-	UL84 ..... 6/6	5Y3GT ... 6/6	6L1 .....10/-	12BA6 ... 7/6	75 ..... 8/-
ECC81 ... 5/-	EL91 ..... 4/-	N369 .....10/6	TDD4.....12/6	UL85 ..... 7/6	5Z4G ... 9/6	6L6 ..... 7/6	12BE6..... 7/6	78 ..... 7/6
ECC82 ... 5/-	EL95 ..... 7/6	OD3 ..... 5/-	TDD13C 17/6	UM80 ...10/6	5Z4GT ...12/6	6L7 .....10/-	12BH7 ...10/-	80 ..... 9/-
ECC83 ... 7/-	EM80 ..... 8/6	OZ4 ..... 5/6	TH41 .....20/-	URIC ...15/-	6A7 ..... 9/-	6L18 .....10/-	12C8 ..... 8/6	85A2 .....12/6
ECC84 ... 8/6	EM81 ..... 8/6	P2 .....10/-	TY86F ...12/6	UU6 .....17/6	6A8G ... 8/6	6L19 .....15/-	12J5GT ... 4/-	185BT ...30/-
	EM84 ..... 9/6	PABC80 13/-	UU8 .....15/-	UY41 ... 7/6	6A8GT ...13/6	6N7GT ... 9/6	12J7GT ... 8/6	807A 7/6
	EM85 .....10/-		UU9 ..... 7/6		6AC7 ..... 6/-	6P25 .....10/6	12K7GT... 5/-	807B 7/-
	EY51 ..... 7/6		UYIN ...12/6		6AK5 ..... 5/-		12K8GT...10/-	

COMPLETE VALVE LIST FREE WITH ORDER

METAL RECTIFIERS

RM1 7/6	14A86	23/-	16RD 2-2-8-1	12/- (FC142)	
RM2 8/-	14A97	26/-	16RE 2-1-8-1	10/- (FC150)	
RM3 10/-	14A100	28/-	18RA 1-1-8-1	5/- (FC118)	
RM4 17/6	14RA 1-2-8-2	21/- (FC301)	18RA 1-1-16-1	7/- (FC116)	
RM5 19/6	14RA 1-2-8-3	25/- (FC31)	18RA 2N-1-8-1	12/-	
	16RC 1-1-16-1	10/-	18RD 2-2-8-1	16/- (FC124)	

TERMS OF BUSINESS C.W.O. or C.O.D.
4/2 PACKING CHARGE ON ALL C.O.D. ORDERS. POSTAGE 6d. per VALVE

BRAND NEW TRANSISTORS

OC44 ... 6/-	OC74 ... 6/-	OC81D 6/-	
OC45 ... 7/-	OC75 ... 6/-	OC82 ... 8/-	
OC71 ... 5/-	OC77 ... 6/-	OC82D 8/-	
OC72 ... 6/-	OC81 ... 6/-		

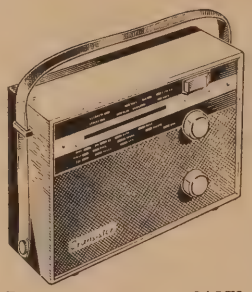
SILICON RECTIFIERS

400 volts 350 mA ..... 7/6 each

SETS OF VALVES

IR5 ,IS5, IT4, 3S4, 3V4 ..... Set of 4, 19/-
DAF91 DF91, DK91, DL92 DL94 ..... Set of 4, 19/-
DAF96, DF96 DK96, DL96 ..... Set of 4, 26/6

5WW—141 FOR FURTHER DETAILS.



"THE CONTESSA"

★COMBINED PORTABLE AND CAR RADIO ★

AMAZING SENSITIVITY AND SELECTIVITY ON MEDIUM AND LONG WAVEBANDS

★ The easiest Superhet Radio to build on the market. Features clearly marked printed circuit and packaged components with full illustrated building instructions. Full tuning of medium and long wave bands with unbeatable sensitivity and selectivity. Excellent tone and volume with over 600-mW push-pull output. ★ Clearly marked horizontal station dial with slow motion tuning. Two colour Blue or Beige cabinets with Gold handles, grilles and fittings. Sizes 10¾ x 7¾ x 3¾in., includes car aerial socket, recording sockets. ★ 6 Mullard Transistors and 2 Diodes. **Guaranteed the Best Obtainable**

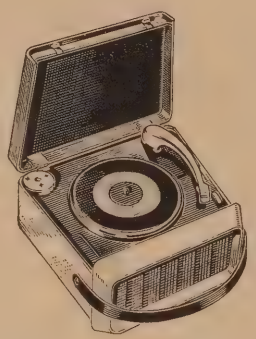
TOTAL COST OF ALL PARTS

£9.19.6 P.P. 3/6.

Fully Detailed and illustrated Leaflet on request.

All parts sold separately.

● **Attractive Appearance—Reliable Design—Unbeatable for Quality and Performance.** ●



"MINI-GRAM" TRANSISTOR PORTABLE RECORD PLAYER

★ **Ready Built 4-transistor 1 watt amplifier with elliptical speaker and volume control, 35/-. P.P. 2/-.**

★ **9 volt 45 r.p.m. turntable with Crystal pick-up, 39/6. P.P. 2/6.**

★ **Two-tone moulded case with handle, 5/-. P.P. 2/-.**

Sold as three pre-built units with less than 30 minutes' interconnection work. Originally sold at more than double the price. A superb record player, fully portable—the ideal gift for teenager or adult.

OR TOTAL COST **79/6** P.P. 5/-.

(Battery 3/9 extra)

NEW VHF TRANSISTOR FM TUNER

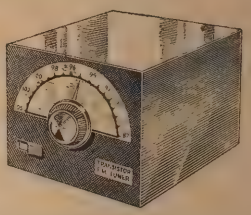
See Dec. 'Radio Constructor'

★ **5 Mullard VHF transistors and 4 diodes.**
★ **A.F.C. and A.V.C.**
★ **Tunes 87 to 105 Mc/s.**
★ **Printed circuit.**
★ **Prealigned I.F.T.s.**

New high gain low noise compact design. 9-volt operated. Output for valve or transistor amplifiers.

★ Size 3½ × 2⅛ × 4".

★ **DETAILS ON REQUEST** ★



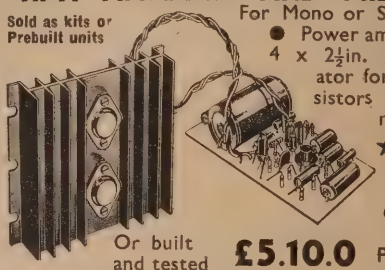
TOTAL COST OF ALL PARTS **£8.19.6** P.P. 2/6

★TOTAL COST LESS CASE **£7.19.6** P.P. 2/6

All parts sold separately and fully guaranteed

10 WATT TRANSISTOR HI-FI AMPLIFIER AND PRE-AMPLIFIER

Sold as kits or Prebuilt units



For Mono or Stereo equipment.

● Power amplifier built on to 4 x 2½in. panel with radiator for outputs. 6 transistors and rectifier: mains or battery.

★ Complete Kit for 24 volt 3 ohm version. **99/6** P.P. 2/6

Or built and tested **£5.10.0** P.P. 2/6

Mains unit **69/6** extra—either version.

★ Complete kit for 40 volt 15 ohm version **£5/10/0.** P.P. 2/6.

Or built and tested **£5/19/6.** P.P. 2/6.

● Full function pre-amplifier and control unit on printed panel 9 x 2½in. operates from any voltage 9 to 40 volts. 5 controls. Input selector, Treble Bass, Filter. 1.5mV sensitivity. Inputs for P.U.s, Tuners, Mics., Tape, etc.

Kit **99/6.** P.P. 2/-. Built **£5/10/-.** P.P. 2/-. **(FRONT PLATE 8/6 EXTRA)**

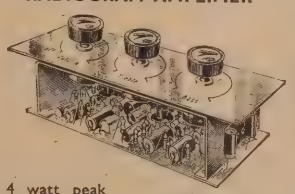
The 24 volt 3 ohm power amplifier can be used on any rectified mains or battery voltage from 4½ to 24 volts. Ideal for loudhailers, public address or equipment amplifiers.

A COMPLETE HI-FI SET UP—ALL TRANSISTOR
NEW DETAILED BOOKLET—FREE ON REQUEST
CALL FOR DEMONSTRATION—ANY TIME

- New Fully retractable car aerial tamper proof..... 35/-
- Transistor Signal injector 39/6
- Stethoscope Mono Head Sets, Crystal..... 10/6; Magnetic 12/6
- Magnetic Stereo Type 25/-
- 4-Transistor 3 ohm. 9 volt 1 watt amplifier, kit 52/6; Built 59/6
- 3 Transistor 125 mW, 9 volt 35/-
- 5 Transistor 350 mW, 9 volt 150 ohm 57/6
- 4 Transistor 250 mW, 9 volt 8/10 ohm 39/6
- Transistor Portable Baby Alarm as previously advertised ... £5 10 0
- 5 Hole Chassis, Punch Kit..... 49/6 P. & P 1/6
- Martin Audio Kits and Record Kits, and add on Preamplifiers available leaflets on request.
- Goodmans, WB and other speakers in stock.
- Crystal Contact Microphone 12/6
- New Range of Professional Dynamic Microphones in Stock.
- ¼/⅛ Watt 5% Hi-Stabs, all values, 6d. each. ½/¼ Watt types, 9d. each.
- Stereo Headphones..... £5/5/-.

NEW TRANSISTOR, RECTIFIER, VALVE and CRYSTAL CATALOGUE—more types—lower prices 8 page catalogue free on request.

7-TRANSISTOR RECORD PLAYER/ RADIOGRAM AMPLIFIER



- 4 watt peak output.
- Full Treble and Bass boost and cut.
- 40 c/s to 20 kc/s ±3dB.
- Inputs for Pick-ups, Radio Tuners, Microphones, mixers, etc.

Built and Ready to Use

£5.19.6

P.P. 2/-. (Complete with full descriptive Booklet)

Call for demonstration.

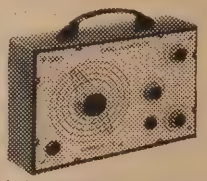
● **TWO VERSIONS AVAILABLE** 12/18 volt for 15 ohm speakers (mains unit extra now only **60/-**). 9/12 volt for 3 ohm speakers (mains unit **49/6** extra).

● Size only 6in. x 2½in. x 2in.

Ideal for mains or battery, portable or domestic record player, grams, etc.

● **Booklet Free on Request** ●

PORTABLE TRANSISTORISED TEST EQUIPMENT



★ **NOMBREX AUDIO GENERATOR.** 10 to 100,000 c/s. Sine/square, **£15/2/3**, with batt.

POST AND PACKING 2/6 ANY TYPE

● **DETAILED LEAFLETS ON REQUEST** ●

★ **NOMBREX ALL TRANSISTOR SIGNAL GENERATOR.** 150 kc/s to 350 mc/s. AF, RF Mod. etc., **£7/18/6** with leads, batt., etc.

★ **NOMBREX TRANSISTORISED RESISTANCE CAPACITANCE BRIDGE.** 1pF to 100 mfd. 1 ohm to 100 meg., leakage test, visual null indicator, **£7/2/3** with batt.

★ **NOMBREX TRANSISTOR POWER SUPPLY UNIT.** 1 to 15 volts D.C. up to 0.1 amp. 230/250V. A.C. mains. **£5/17/6.**

★ **TRANSISTOR INJECTOR KIT. 27/6.** P.P. 1/-.
★ **SINCLAIR SLIMLINE, 49/6.** P.P. 1/6.
★ **TRANSISTOR 4-CHANNEL MIXER UNIT, 59/6.**
★ **TAPE JACK TUNER,** Med. Wave, **29/-.** P.P. 1/-.
★ **CHASSIS PUNCH KIT,** 5 piece, ⅛in. to 1⅜in., **49/6.**
★ **HEADPHONES,** 2000 ohm, **12/6;** 4000 ohm, **14/-.**

CINTEL ALL TRANSISTOR COUNTER. Up to 1 Mc/s. **£125.** Brochure on Request.

HENRY'S RADIO LTD.

303 EDGWARE ROAD, PADDINGTON, LONDON, W.2.

OPEN ALL DAY SATURDAY. **100 yards from Edgware Road Tube Station.**

PADdington 1008/9. OPEN MON. TO SAT. 9-6. THURS. 1 o'clock.

● *CALL IN AND SEE US — ANY TIME* ● *ELECTRONIC COMPONENT SPECIALISTS* ●

68-PAGE FULLY DETAILED AND ILLUSTRATED CATALOGUE

(SIZE 10 x 7½in.) 2/- POST FREE

LET US QUOTE FOR COMPONENTS FOR YOUR CIRCUIT.

(New 8-page Valve, Transistor, Rectifier and Crystal Catalogue now ready 1/-.)

TRANSISTORS, CRYSTALS, VALVES, COMPONENTS & EQUIPMENT

FOR THE AMATEUR AND PROFESSIONAL — QUOTATIONS BY RETURN — TRADE SUPPLIED

MULTI-RANGE TESTMETERS

★ PT34	1 K ohm/volt	£2	5 0
★ MI	2 „ „	£2	9 6
★ THL33	2 „ „	£3	15 0
★ EP10K	10 „ „	£4	9 6*
★ ITI-2(200H)	20 „ „ (illus)	£5	5 0
★ TP5S	20 „ „	£5	19 6*
★ EP30K	30 „ „	£6	19 6*
★ 500	30 „ „	£8	19 6*
★ EP50K	50 „ „	£9	19 6

* Leather case available.

FIELD STRENGTH METER

Five channels cover 1 Mc/s to 200 Mc/s. Fitted 200 microamp meter for CW or R.F. Indication and Earphone for A.F. monitoring. Designed for checking all types of transmitters. Size 4 x 2¾ x 2½in. Complete. Ready to Use. with instructions and telescopic aerial, **69/6.** Post Free.

STEREO AMPLIFIERS

Complete with full function pre-amplifiers and controls.

★ SA80 4+4 watts **£9/10/-.**
★ SA150 7+7 watts **£16/10/-.**
★ SA300 15+15 watts **£32/10/-.**

Each amplifier completely self contained and designed for Mono and Stereo output. Supplied complete with full manual. Leaflets on any type on request.

SUBSTITUTION BOXES

- Capacitor Box. Provides 9 standard values from 0.001 to 0.22 mfd. at 600 volt working, **29/6.**
- Resistor Box. Provides 24 standard values at 1 watt. 15 ohms to 10 meg., **37/6.**

Each box fully calibrated with insulated leads. Invaluable for service and design.

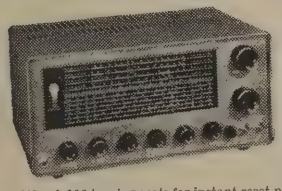
100Kc/s QUARTZ CRYSTALS

2 Pin: OCTAL or 3 Pin **15/-** ea.

500 Kc/s. 2 Pin.....	15/-
455 Kc/s. (AR88).....	12/6
HRO 456 Kc/s.....	15/-
5000 Kc/s. 2 Pin.....	10/-
10 Mc/s. 2 Pin.....	15/-
27.255 Mc/s. Radio Control	15/-
HC6U 18 Mc/s. to 46 Mc/s.	7/6

80 frequencies 0.005% Acc. Over 600 frequencies in stock. See new crystal lists.

THE HE-30 4-BAND COMMUNICATION RECEIVER



Outstanding Bandspread Selectivity and sensitivity with a built-in Q-multiplier combine to make the HE30 one of the finest general coverage bandspread Receivers available at this price. Covering 550 kc/s-1600 kc/s, 4.8 Mc/s.-14.5 Mc/s., 1.6 cm. 4.8 Mc/s., 10.5 Mc/s-30 Mc/s. For amateur bands an illuminated slide rule dial is provided, calibrated every 5 kc/s. on 80 and 40 metres taking 16 revolutions of the bandspread dial to cover each of these bands every 20 kc/s. on 20 and 15 metres and every 15 kc/s. on 10 metres plus an edgewise S-meter. For the SWL a 0-100 logging scale for instant reset plus coverage from 0.55-30 Mc/s. The 8-valve plus Rectifier superhet circuit provides an RF stage with an Aerial Trimmer for peak performance plus 2 IF stages for improved sensitivity of 1.0 microvolts for 10db S/N ratio. The BFO variable pitch control can be used to separate CW stations whilst the Q-multiplier adds the selectivity needed for crowded phone band operation. Controls: Function Switch, Audio Gain, Selectivity (Q-multiplier), Frequency (BFO), Band Selector, IF gain, Trimmer, AVC-MCV Switch, Ant Switch, Main Tuning, Bandspread Tuning and Headphone Jack. Selectivity—60db at 10 kc/s., 0.8 kc/s. at 6 db (with Q-Multiplier), IF—455 kc/s., External P.M. Speaker reqd. 4 or 8 ohms impedance. Output 1.5 watts. 8 modern Miniature B7G Base Valves and 5Y3 Rectifier. Size 15 × 10 × 7¾in. Grey crackle finish. Full instructions and circuit diagram supplied.

40 Gns. Carriage Free.

• LEAFLET ON REQUEST •

BOAC VHF POCKET RECEIVERS

★Features 5-transistors (V6/8R = OC44) 2-OA91 diodes, V.H.F. detector, OA10 rectifier.
★1K ohm Stethoscope headset
★3.9 volt 450 mA/H rechargeable deac cells.
★Moulded case with aerial/strap.
★Full circuit and details.
●Deac separately, 12/6. P.P. 1/6.
●Headset separately, 15/-. P.P. 1/-.
●Unit without above cell and phone, 12/6. P.P. 1/6.
●Complete with circuit, 35/-. P.P. 2/-.

Ideal for experimental receivers—personal locators, etc.

TAPE RECORDER KITS

- COLLARO STUDIO 2-TRACK DECK, **10 Gns.** P.P. 5/-.
- 4-TRACK DECK, **£13/19/6.** P.P. 5/-.
- CABINET with SPEAKER for either of above, **5 gns.** P.P. 2/-.
- RECORD/PLAY AMPLIFIER KITS, 2 track, **11 gns.** 4 track, **12 gns.**

Leaflets on Request.

RECORDING TAPE

3in. 150ft. **5/3**; 5in. 600ft. **12/6**; 5in. 900ft. **15/-**; 7in. 1,200ft. **18/6**; 7in. 1,800ft. **25/-**; 7in. 2,400ft. **27/6.** Excellent quality.

HI-FI SPEAKERS

8A7 15/16 ohm, 6 watt, double cone **79/6**
CX300 15/16 ohm, 25 watt, triple cones ..... **12 gns.**
CR10AE 15/16 ohm, 20 watt, double cones ..... **8 gns.**
CR30AE Triple cone, 20 watt, 15/16 ohm ..... **10 gns.**
10 watt Horn Tweeters **29/6**
P.P. 1/6.

SR40 OR RX60 4-WAVE-BAND COMMUNICATIONS RECEIVER

4-valve version of HE30—similar in appearance. BFO—bandspread. "S" meter, Noise Limiter, etc. 550 kc/s. to 30 Mc/s. Size 13⅜in. x 8½in. x 5⅝in. Weight 12lbs. **£24/15/-.** Carr. & Pkg. 12/6

Leaflet on Request.

Cathodeon Miniature Crystal Oven

6 or 12 volt A.C./D.C. 80°C. for HC6U or 2M crystals. Brand new, **22/6.** P.P. 1/-.

- **GS10CS Dekatron Display Tubes 25/-.** Base 2/-.
- **931A Photomultipliers, 60/-,** with base.
- **Large range of Special Valves in stock.**

METER BARGAINS

50 Microamp 2½in. square MC... **35/-**
0/100μA 2½in.fr.D.C. **35/-**
1 mA. 2½in. flush round..... **30/-**
2⅜in. Moving Coil double range Voltmeter, centre zero. 30-0-30 and 3-0-3 volts. Ideal for transistor tester or voltage measurements, **12/6,** post free.
0/500μA 2in..... **15/-**
0/500μA. 2½in. flush mounting, D.C. **20/-**
2½-0-2½ mA., 2½in. flush D.C. **12/6**
0/15 volt M.I. 2½in. FR. A.C. **8/6**
0/50μA (D.C.) 4in. square, clear front **59/6** p.p. 1/6.

MINIATURE PANEL METERS

*0/50μA (D.C.) **39/6** *0/5mA (D.C.) **27/6**
*0/500μA(D.C.) **32/6** *0/300V(D.C.) **27/6**
*0/1 mA (D.C.) **27/6** Vu Meter **42/6**
"S" Meter **35/-.** All Brand New Boxed
*Available Clear Plastic Front or Black Moulded. State which.

SILICON FINNED FULL WAVE BRIDGE ASSEMBLY

100 PIV 160 amps. Made by G.E. (U.S.A.)
£10 EACH BRAND NEW In Cartons

ZENER REFERENCE DIODES

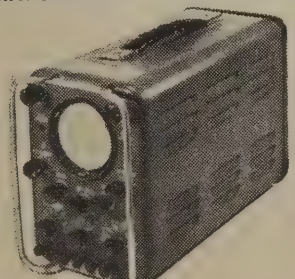
★ 1N430 8 to 8.8 volt, 0.2% stability from —55°C to + 100°C.... **45/-** ea.
★ 1N429 5.9 to 6.5 volt. 1% stability from —55°C to + 100°C... **15/-** ea.

SILICON RECTIFIERS

100 PIV 65 v. RMS 3 amp.....	10/-
400 PIV 280 v RMS 3 amp.....	10/-
600 PIV 420 v. RMS 3 amp.....	17/6
400 PIV 280 v. RMS 1½ amp.....	10/-
100 PIV 45 v. RMS 20 amp.....	35/-
200 PIV 35 amp.	45/-
50 PIV 110 amp.	75/-
50 PIV 250 amp.	85/-

BRAND NEW.

MINIATURE OSCILLOSCOPE MODEL CT84



High sensitivity 'scope, fully portable with Mullard DG7/5 2¾in. tube. Gain ±2dB to 2 Mc/s. 10μ sec. to 60 m/sec. sweep. 24 volt operated. Full controls and input facilities, complete in portable cases.

£16/10/-. Carr. & Pkg. 7/6. BARGAIN BUY—LIMITED NUMBER

LEAFLET ON REQUEST

CRYSTAL MICROPHONES

Also Range of Dynamic Types in stock. (See Catalogue for details)

Acos 60/1 Stick Microphone	27/6
Acos 39-1 Stick Microphone	32/6
Acos 40 Desk Microphone	15/-
Acos 45 Hand Microphone	22/6
Lapel/Hand Microphone Crystal.....	12/6
100C Stick with Stand fitted muting	39/6
BM3 Stick with Stand fitted muting	49/6
Lapel/Hand Magnetic	12/6

Post and Packing 1/6 any type.

MAINS AND BATTERY RECORD DECKS

★ BSR UA14 4-speed with head	£5	19	6
★ Garrard Autoslim, 4-speed „	£6	10	0
★ Unplugable Head Version „	£6	19	6
or Stereo Version „	£7	10	0
★ SRP10 4-speed or BSRGU7 „	£5	5	0
★ Garrard AT6 with Stereo Cartridge, 4-speed.....	£10	19	6
★ AT6 with Mono head.....	£10	10	0

P. & P. 5/- any type above.

★ 9 volt Star, 45 r.p.m. with head	39/6
★ 45 and 33 r.p.m. Star, 9V „ „	92/6
★ 45 r.p.m. Garrard, 6V... „ „	35/-
★ 4-speed B.S.R., 9V ... „ „	5 gns.

P. & P. 3/6 any of above.

Henry's Radio Ltd.

303 EDGWARE ROAD, LONDON, W.2
PADdington 1008/9
Open Monday to Sat. 9-6. Thurs. 1 o'clock.

LASKY'S RADIO

London's Largest Stocks of

THE HOME OF HI-FI

COMPLETE MONO/STEREO SYSTEMS TO YOUR SPEC. AT LASKY'S PRIVILEGE PARCEL PRICES.

DEMONSTRATION STUDIOS

Hear and compare the very latest

HI-FI EQUIPMENT

Visit our spacious showrooms at 33 Tottenham Court Road or 207 Edgware Road, whichever is most convenient. In our Demonstration Studios you can see, examine, hear and compare the very latest products in the realm of high-fidelity reproduction.

• TAPE RECORDERS • TAPE DECKS • MICROPHONES • AMPLIFIERS • CONTROL UNITS • AM/FM TUNERS • RECORD PLAYERS • AUTOCHANGERS • TRANSCRIPTION TURNTABLES • PICK-UPS • LOUDSPEAKERS • SPEAKER SYSTEMS • CABINETS AND ENCLOSURES • TRANSISTOR RADIOS

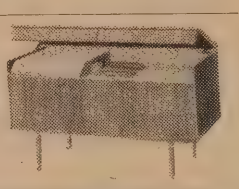
by all the well-known makers including:—

ARMSTRONG	G.E.C.	LORENZ	STELLA
BRENELL	GOLDRING	LOWTHER	STUZZI
CHAPMAN	GOODMANS	LUSTRAPHONE	TANDBERG
COLLARO	GRUNDIG	ORTOFON	TANNOY
CONNOISSEUR	HARTING	PAMPHONIC	TELEFUNKEN
COSSOR	H.M.V.	PHILIPS	THORENS
DULCI	JASON	QUAD	TRUVOX
E.A.R.	KORTING	RESLO	VORTEXION
ELIZABETHAN	LEAK	ROGERS	W.B.
FERROGRAPH	LENCO	SIMON	WEARITE
FI-CORD	LINEAR	SOUND	WHARFEDALE
GARRARD			

If you cannot pay us a visit please send us details of your choice of equipment and we shall be pleased to quote. See Complete Systems.

HI-FI FURNITURE

by RECORD HOUSING



The full range of Record Housing equipment cabinets, speaker enclosures, etc., stocked. Delivered anywhere. Catalogue FREE on request.

RECORD PLAYERS

4-SPEED AUTO-CHANGERS

B.S.R. Type UA14/UA20 ..... £5 19 6

COLLARO Studio C60 wired for stereo with monaural p.u. £6 19 6

MAGNAVOX-COLLARO latest model, 4-speed Stereo Auto changer. Fitted diamond stylus and record dust cleaning attachment. Stereo £7 19 6

GARRARD

Auto-Slim Mono	£6 10 0
Auto-Slim Stereo	£7 10 0
Auto-Slim Mono Plug-in-head	£7 7 0
Auto-Slim De Luxe Mono AT6	£11 9 0
Auto-Slim De Luxe Stereo AT6	£12 5 0
Lab. Model " A " Mono	£19 14 0
Lab. Model " A " Stereo	£20 10 0

Postage on all above 5/-.

H.M.V. 45 r.p.m. AUTOMATIC RECORD PLAYER

Designed to take only 45 r.p.m. 7in. discs. Will play up to 8 automatically. Fitted with lightweight pick-up and crystal cartridge mounted on a plinth. For 200/250 v. A.C. mains. Size approx. 10 × 10 × 5in.

LASKY'S PRICE 69/6. Post & Pkg. 3/6 extra.

TRANSCRIPTION MOTORS

GARRARD 4HF, stereo or mono £16 19 6

GARRARD 301	£20 12 0
GARRARD 301 (Strobe)	£22 0 0
GARRARD A with GC8	£19 14 0
GARRARD A with GSC10	£20 10 0
PHILIPS AG/1016	£12 12 0
BRAUN PC4L Stereo ..	£12 9 6

Also Lenco, Connoisseur, Thorens, etc. Carr. & Ins. 5/-

COLLARO 4TR 200 Transcription Motor & Turntable New and unused—listed at 17 gns. **LASKY'S PRICE £9/19/6.** Carr. & Pack. 5/-.

SINGLE PLAYERS

Auto start and stop. With pick-up and crystal cartridge.

GARRARD T.A. Mk. II Mono £7 17 3

GARRARD SRP10 latest model single player with G.C.S. £5 9 11

E.M.I. 4-speed STEREO £3 19 6

Post on all above 5/-.

COLLARO JUNIOR 4-speed motor and pick-up 69/6

6 volt battery version, 4-speed with pick-up 99/6

B.S.R. TU9, non-auto. Turntable and pick-up 59/6

EMI 4-SPEED RECORD PLAYER

New, unused and individually boxed fitted with lightweight pick-up with ACOS G.P. 73/2 stereo cartridge. Cabinet space required 13½ × 12½ × 4½in. A 9in. metal turntable is fitted. For use on 200/250 volt A.C. Mains with Auto-stop. The stereo cartridge will play all types of Mono Records, 78s, L.Ps. etc., but if desired a G.P. 67 LP/78 Mono cartridge will be supplied in lieu of the GP73 at no difference in cost.

LASKY'S PRICE 79/6 P. & P. 3/6.

AMPLIFIERS

STEREO AMPLIFIER

LASKY'S PRICE £15 Carriage & Packing 7/6

Self-contained integrated stereo amplifier, including combined control unit pre-amplifier. Designed to provide high quality stereo and mono reproduction with a rated output of 6 watts per channel sterco, 12 watts mono. Input sockets are provided for the direct connection of most types of tuners and pick-ups, plus tape heads and high quality microphones including moving coil and ribbon. Separate output for feeding a tape recorder, available on each channel. Facilities include inputs for Mic. 5 m/v.; tape 4 m/v.—equalised for CCIR; RIAA. 4.3 m/v.; flat 250 m/v; radio tuner 100 m/v. Overall response 60 cycles—20,000 cycles. Controls fitted are bass, treble, balance volume, phase reverse stereo sense and selector. Outputs, 4, 8 and 16 ohms. Mains voltage 105-240 v. A.C. Attractively styled in free-standing metal case, finished in silver and black. Size: 14 × 8 × 4 inches. Suitable for use with any good quality tuner, speaker system, record players, etc. Will form the basis of a hgh fidelity stereo system. Brand New and Unused in maker's original cartons.

SCOOP! MAKER'S SURPLUS FM TUNER CHASSIS

A factory built FM Tuner using the Gorler front end unit and I.Fs' Freq. range: 88-108 Mc/s. Valve line-up: 6AL5; 3×6AU6; ECC85; Fully assembled on printed circuit. Illuminated glass dial. Overal size 12 × 5 × 3in. Unpowered—requires 6.3 v. L.T. and 200 v. at 40 m/a H.T. Full circuit data included.

LASKY'S PRICE £5.19.6 Post and Pkg. 6/-.

"LINEAR" AND ARMSTRONG EQUIPMENT

"LINEAR" AMPLIFIERS

" Diatonic " 10-14 watt ..	12 Gns.
" Concord " 30-watt....	16 Gns.
L45, 4-5 watt.....	£5 19 6
LT45 Tape Deck Amp. ..	12 Gns.
L10 10-watt with pre-amp.	15 Gns.
L50 50-watt	22 Gns.
L5/5 Amplifier and Pre-amp.	12 Gns.
LP1 Tape Pre-amp.	9 Gns.

ARMSTRONG EQUIPMENT

A.F.208. £21/4/-	T.4.c. £17/19/-
Model 227M £33/18/-	T.4.b. £20/8/-
Stereo 55 £29/18/-	S.T.3. Mk. II £25/12/-
Model227 £48/15/-	A.20 Stereo Amp £23/12/6.
Model 226 £56	P.C.U. 25 Stereo Pre-Amp. £21.
Model 222 Amp. £27/10/-	

COMPLETE SYSTEMS

PRIVILEGE PARCELS

A " Privilege Parcel " allows you to purchase the Audio System of your choice at a worth-while cash saving. Some examples are listed below, but we shall be pleased to quote our " Privilege Parcel " Prices for any selection of equipment of your own choice. Send us details of your requirements.

Tudor Stereo Amplifier	£15 0 0
Connoisseur Craftsman, 2-speed transcription player	£16 6 6
Decca FFSS Stereo Pick-up	£18 18 0
Total	£50 4 6
" Privilege Parcel " Price	£47/10/-.

Tudor Stereo Amplifier..	£15 0 0
Braun PC4L Stereo Transcription Unit	£12 9 6
2x Sharon Loudspeaker Systems	£19 19 0
Total	£47 8 6
" Privilege Parcel," Price:	£45.

Collaro Studio Tape Deck ¼ track model	£10 10 0
Lasky's Tape Amplifier..	£8 19 6
Portable Case	£3 15 0
7 × 4in. speaker	15 6
Total	£24 0 0
" Privilege Parcel " Price:	£22/10/-.

Collaro Studio Tape Deck, ¼ Track Model.....	£13 19 6
Martin Tape Amplifier, ¼ track model.....	£12 12 0
Portable Case with Speaker	£5 5 0
Total	£31 16 6
" Privilege Parcel " Price:	£30.

Carriage and Packing on all the above parcels, 10/6 extra.

STOP PRESS! *NOW AVAILABLE*

MARTIN TRANSISTORISED AUDIOKITS

6 UNIT KITS offering the Hi-Fi enthusiast a new quality construction technique.

KIT 1. 5-stage Matching Input Selector Unit **PRICE 47/6.**
KIT 2. Pre-amplifier with volume control. **PRICE 37/6.**
KIT 3. 3-Channel Mixer with plug in adaptors for individually matching each circuit. **PRICE 79/6.** Adaptors **8/6** each.
KIT 4. Pre-amplifier with tone/volume control stages. **PRICE 62/6.**
KIT 5. 10 and 3 watt Main Amplifiers. **PRICE £5 12/6.**
KIT 6. Power supply convertor unit. **PRICE 52/6.**

LASKY'S FOR ALL TEST GEAR & TECHNICAL ADVICE

5WW—144 FOR FURTHER DETAILS.

Audio Equipment & Components

& TAPE RECORDERS

THE FINEST RANGE OF MONO/STEREO STUDIO AND TRANSISTORISED PORTABLES

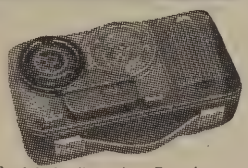
LASKY'S RADIO

TRANSISTORISED

The "CLARION" PHONOTRIX

A fully transistorised battery operated recorder. With leather case. Carr. 7/6.

LASKY'S PRICE 16 GNS.



Very Latest "PHONOTRIX"

with push-pull output. Carr. 7/6.

LASKY'S PRICE 20 GNS.

For full details of these Recorders, see previous adverts.

CLARION "TWINSET"

Transistor amplifier with 7in. × 4in. speaker in a portable case. The Clarion Phonotrix recorder can be housed in the case with the amplifier, this giving full quality output. Listed at 8 gns. **LASKY'S PRICE 7 GNS.** P. & P. 5/-.

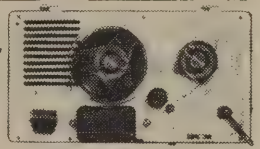
THE "MINY"

A self-contained Transistor Battery Recorder. Size only 8 × 7½ × 2½in. Weight 3½lb. Takes 3in. spools, twin track, 3¾ i.p.s. With tape, mic. and batteries. **LASKY'S PRICE 7½ GNS.** P. & P. 5/-.

THE "TRAV-LER" TRANSISTORISED PORTABLE TAPE RECORDERS

Full details as previously advertised Wireless World (Jan. '64). Last few available. **LASKY'S PRICE 13 GNS.** Carr. & Ins. 17/6 extra.

The Conet



Fully transistorised 2 speed Battery Tape Recorder. This is a high quality machine incorporating features usually found in machines 3 times the price. ● Capstan drive. ● 2 speeds, 3¾ and 1⅞ i.p.s. ● Rec. level meter. ● Fast re-wind. ● All-metal case. ● Uses standard pen torch batteries with easy load containers. ● Twin tracks. ● 2½in. speaker. ● Accessories included: Real Leather carrying case, Microphone, Telephone adaptor, Personal earphone.

A REALLY SUPERB RECORDER BRAND NEW & UNUSED **LASKY'S PRICE 19 GNS.**

Optional Extras. Remote Control Mic. 35/-. Remote Control Foot Switch 25/-.

CONSTRUCTORS BARGAINS

BUILD A HIGH QUALITY TAPE RECORDER

Using the famous Collaro "STUDIO" deck and MARTIN pre-assembled amplifiers 2 or 4 track models.

COLLARO STUDIO TAPE DECK

Latest model 3 speed, 3 motors. Take 7in. reels. Fitted with half-track heads. **LASKY'S PRICE £10/10/-.** New and Unused. Carr. and Pack. 7/6.

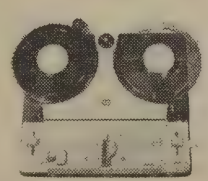
COLLARO STUDIO TAPE DECK. As above but fitted with the latest quarter-trackheads. **LASKY'S PRICE £13/19/6.** Carr. and Pack. 7/6.

MARTIN TAPE RECORDER AMPS. Designed for use with Collaro Studio Tape Deck. In sub assemblies for immediate installation. 6-valve circuit. Comprehensive instructions make final assembly as simple as possible. Everything supplied, including valves, etc. Monitoring facilities. 3-ohm output, speed equalising, etc. For 200-250 v. A.C. mains.

PRICE ¼-track Model **£11/11/-.** ½-track Model **£12/12/-.** P. & P. 2/6.

Portable carrying case designed to take the Collaro studio tape deck and the Martin tape amplifier. Fitted with 9in. × 5in. speaker. Price complete with speaker **£5/5/-.** P. & P. 5/-.

NOW AVAILABLE TO THE HOME CONSTRUCTOR



The latest E.I.M. tape deck. Four tracks: 2 speeds 3¾ and 7½ i.p.s., 3 motors, clock position indicator. Full facilities for 4 track stereo and mono. Frequency response 30-20,000 c/s at 7½ i.p.s. 3dB. Wow and flutter <0.15% at 7½ i.p.s. For 200-250 volt 50 c.p.s. Mains capstan drive, fast forward and fast re-wind. Unit plate size 13¾ × 12½in. depth below top of plate 3¾in. Takes 7in. diameter spools. Pause control. **Today's list value 28 gns.**

LASKY'S PRICE £17.19.6

Carr. and pack. 10/6 extra.

Brand new and unused in makers' original cartons.

HI-FI TAPE RECORDER HEADS

High Impedance Record Play. Low impedance erase. Upper or lower track.

State track required when ordering.

LASKY'S PRICE 29/6 Post free Per pair.

MARRIOTT "X" Type ¼ track heads. Record/play and erase. **LASKY'S PRICE 4 GNS.** pair.

¼ Track heads record/play and erase 59/6 pair

HUGE PURCHASE OFFER

All Brand New and Unused, in perfect working order.

Supplied complete with crystal microphone, reel of tape and empty spool, also screened lead for recording from radio, pick-up, etc.

The following specifications are common to all three models: Tone Control Visual Recording Indicator. Inputs: Microphone, Radio, Record-Player, Radiogram, Telephone Adaptor, Fully Automatic Erase. **Facilities:** Fast spooling, forward and reverse. **Valves:** Latest Mullard Miniature types. **Rectifier:** S.T.C. or Westinghouse Metal Rectifier. **Loudspeaker:** Standard 3 ohm with extension speaker socket. **Microphone:** new super sensitive crystal in the new easy to hold microphone case.

Carrying Case: Portable case with detachable lid, harmonising gold trim and automatic safety locks. Storage cubby for microphone and accessories covered in. New type washable scratch resistant Vinyl.

Size for Models A and B: 14½ × 14 × 6½in. Size for Model C: 14 × 12½ × 6½

MODEL A

Studio Deck, Four Track. Speeds: 1⅞, 3¾ and 7½ i.p.s. Spool capacity: 7in. Wow and Flutter: Less than 0.15% total. Playing Times: up to 18 hours. Frequency Response: 12,000 c.p.s. at 7½ i.p.s. Mains Voltage: 200-250 v. 50 c/s A.C. Output 3 watts.

LASKY'S PRICE 27 GNS.

Carriage & Insurance 15/- extra.

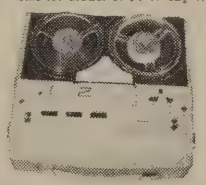
MODEL B

STUDIO DECK, TWO TRACK

Specification as for Four Track model above, except that this is fitted with Two Track Studio Tape Deck. Maximum Playing Time up to 9 hours from one reel of tape.

LASKY'S PRICE 25 GNS.

Carriage & Insurance 15/- extra.



MODEL C

Fitted with B.S.R. Deck., two-track version. Specification: Single speed, 3¾ i.p.s. Freq. response 10,000 c.p.s. at 3¾ i.p.s. Spool capacity: 5½in. Mains Voltage: 200-250 v. 50/60 c/s. A.C. Wow and Flutter: Less than 0.2% total. Output: 3 watts. Playing time: up to 3 hours.

LASKY'S PRICE 18 GNS.

Carriage & Insurance 15/- extra.

MODEL D

Fitted with B.S.R. Four Track Deck—otherwise same specification as the Model C—but maximum playing time increased up to 6 hrs.

LASKY'S PRICE 21 GNS. Carriage & Insurance 15/- extra.

TAPE DECK MOTORS

Motors for the Collaro Studio Deck—new and unused. 200-250 v. A.C. Take-up; rewind and capstan. Listed at £2/5/- each.

LASKY'S PRICE 14/11 each P. & P. 2/6.

Set of 3 35/-. P. & P. 6/-.

MICROPHONES

ACOS CRYSTAL STICK MIC. Type MIC. 39/1, complete with Cable. List £5/5/-. **LASKY'S PRICE 32/6.** Post free.

Crystal Head or Table Mic. 15/-. Post free.

LAPEL TYPE MP110. High imp. xtal mic. 1⅛in. dia. × ⅝in. thick **15/-.** Post 1/-.

TYPE NP100. Tie clip mic., 1 × ⅝ × ⅜in. High imp. xtal, **22/6.** Post 1/-.

BRENELL TAPE EQUIPMENT

We stock the full range of this well-known equipment

Mark V Series II Tape Deck from **31** gns.
Mark 510 Series II Tape Deck from **43** gns.
Mark V Series II Record/Play Amp. from **£26**
Mark V Series II Tape Recorder **69** gns.
Mark V Series II Tape Recorder with meter..... **75** gns.
S.T.B. 1/5/2 Recorder. **£120.**

LAFAYETTE BRAND TAPE

FULLY GUARANTEED AT RECORD LOW PRICES

MYLAR BASE		ACETATE BASE	
5in. Double play, 1,200ft.	15/-	5in. Long play, 900ft...	10/-
5½in. Long play, 1,200ft.	15/-	5½in. Long play, 1,200ft.	12/6
5½in. Double play, 1,800ft.	22/6	7in. Long play, 1,800ft.	15/-
7in. Stand. play, 1,200ft.	12/6	**MESSAGE TAPES**	
7in. Long play, 1,800ft.	19/6	3in.—150ft.....	3/6
7in. Double play, 2,400ft.	25/-	3in.—225ft.	4/11
P.V.C. BASE		5in.—300ft.	7/6
5in. Standard play, 600ft.	8/6	**All other makes, types and sizes**	
5½in. Standard play, 850ft.	11/6	**in stock.**	

P. & P. 1/- extra per reel: 4 reels and over Post Free.

LASKY'S FOR D.I.Y. CONSTRUCTION BARGAINS

P.T.O. FOR MORE NEWS

5WW—145 FOR FURTHER DETAILS.

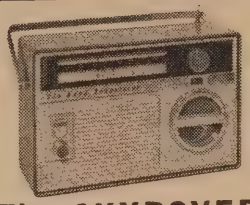
LASKY'S RADIO

For The Finest Value and

TRANSISTOR RECEIVERS &

THE WIDEST RANGE AVAILABLE TODAY FOR HOME CONSTRUCTION OR READY BUILT TO HIGHEST STANDARDS

We consider our Construction Parcels to be the finest value available on the home construction market. If on receipt you feel not competent to build the set, you may return it as received within 7 days, when the sum paid will be refunded less postage.



The SKYROVER

Controls: Waveband Selector, Volume Control with on/off Switch, Tuning Control. In plastic cabinet, size 10 × 6½ × 3¼in. with metal trim and carrying handle.

Can be built for **£10 . 19 . 6**

Post & Pkg. 5/- extra.

THE SKYROVER & THE SKYROVER DE LUXE

GENERAL SPECIFICATION:
7 transistor plus 2 diode superhet, 6 waveband portable receiver. Operating from four 1.5 torch batteries.
The SKYROVER and SKYROVER DE LUXE covers the full Medium Waveband and Short Waveband 31-94 M, and also 4 separate switched band-spread ranges, 13M, 16M, 19M and 25M, with Band Spread Tuning for accurate Station Selection. The coil pack and tuning heart is completely factory assembled, wired and tested. The remaining assembly can be completed in under three hours from our easy to follow, stage by stage instructions.

SPECIFICATION:
Superhet, 470 Kc/s.
Uses 4-U2 batteries.
Easy to read Dial Scale.
500 MW Output.
All Mullard Transistors and Diode.
5in. Ceramic Magnet P.M. Speaker.
Band Spread Tuning.
Telescopic Aerial and Ferrite Rod Aerial.

WAVEBAND COVERAGE: 180-576M; 31-94M and Band Spread on 13, 16, 19 and 25 metre Bands.

Data for each receiver: 2/6 extra. Refunded if you purchase the parcel. Four U2 batteries, 2/8 extra. Four Leak-Proof batteries, 3/4 extra. *All components available separately.*

The SKYROVER DE LUXE

Tone Control Circuit is incorporated, with separate Tone Control in addition to Volume Control, Tuning Control and Waveband Selector. In a wood cabinet, size 11¼ × 6½ × 3in. covered with a washable material, with plastic trim and carrying handle. Also car aerial socket fitted.

Can be built for **£12.19.6** P. & P. 5/- extra.

Can be built for

£5 . 19 . 6

P. & P. 4/6

REALISTIC SEVEN

Fully tunable long and medium bands. Uses 7 Mullard Transistors; plus Diode OA70.

STAR features:
★ 7 Transistor Superhet. ★ 350 Milliwatt output 4in. high flux speaker. ★ All components mounted on a single printed circuit board, size 5¼in. × 5¼in. in one complete assembly. ★ Plastic cabinet, with carrying handle, size 7in. × 10in. × 3¼in., in blue/grey. ★ Easy to read dial. ★ External socket for car aerial. ★ I.L.-frequency 470 Kc/s. ★ Ferrite rod internal aerial. ★ Operates from PP9 or similar batt. ★ Full comprehensive data supplied with each Receiver. ★ All coils and I.F.s, etc. fully wound ready for immediate assembly. An outstanding Receiver.

REALISTIC SEVEN DE LUXE

By popular request a De Luxe version of the well-proven Realistic Seven now available. With the same electrical specification as standard model—PLUS A SUPERIOR WOOD CABINET IN CONTEMPORARY STYLING covered in attractive washable material, with superchrome trim and carrying handle. Also a full vision circular dial, externally mounted to further enhance the pleasant styling. **ALL FOR ONLY £1 EXTRA.** Battery 3/9 Extra. (All components available separately.) Data and instructions separately 2/6, refunded if you purchase parcel.

THE SPRITE

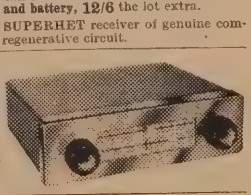
★ 6-Transistor Superhet Mini Personal Pocket Radio. ★ Long and Med. wavebands. ★ Uses PP3 batt. ★ Ferrite Rod aerial. ★ I.F. Freq. 470 Kc/s. ★ 3in. speaker. ★ Printed circuit 2¼in. × 2¼in. ★ Slow-motion Drive. ★ Plastic case, size 4in. × 2¼in. × ¾in.

In order to ensure perfect results, the SPRITE is supplied to you with R.F. and I.F. stages. Driver and Output stages, ready built with all components ready mounted on the printed circuit. The SPRITE pre-assembled plus cabinet, speaker and all components for final construction. **CAN BE BUILT FOR 79/6.** Post and pack. 3/6 extra. Data and instructions separately, 2/6. (Refunded if parcel is purchased.) **Real calf leather case, wrist strap, personal earphone, case for earphone and battery, 12/6** the lot extra.

CAN BE BUILT FOR **79/6** P. & P. 3/6 extra.

Make no mistake—this is a SUPERHET receiver of genuine commercial quality. It is not a regenerative circuit.

LASKY'S CAR RADIO



Superhet 470 Kc/s. I.F. with Tuned R.F. stage 12 v. operation. Transistor output. Medium and Long waves. Permeability tuning. T.C.C. Printed Circuit. Small size, will fit any car.

CAN BE BUILT COMPLETE WITH SPEAKER FOR 29/19/6. Post 3/6. Booklet 2/6 (refunded if you order).

TRANSISTORS

ALL BRAND NEW AND GUARANTEED

GET 81, GET 85, GET 86 **2/6**; 837A, 874P **3/6**; OC 45, OC 71, OC 81D **4/6**; OC 44, OC70, OC 76, OC 81 (match pair **10/6**) **5/6**; AF 117, OC 72, OC 75, OC 170, OC 171, OC 200 **6/6**; OC 25, OC 42, OC 43, OC 73, OC 82D **7/6**; OCP 71 **9/6**; OC 28, OC 201, OC 204 **15/-**; OC 205, OC 206 **19/6.**

MINIATURE EARPIECES

for Transistor Radios. Transparent ear inserts with 3ft. cord, sub-min. jack and socket. Fully guaranteed. Post free.

OR.5 Crystal high imp..... 5 0
MR.4. Magnetic low imp..... 6 6

READY BUILT

BOYS TRANSISTOR RADIO

2 transistor pocket radio. In attractive plastic case. Size only 4in. × 2¾in. × 1in. Fitted with 2¼in. loudspeaker. Socket for personal earpiece and telescopic aerial. Works from single PP3 type battery. Fully tunable over full medium waveband. Supplied complete with earpiece, telescopic aerial, carrying purse and 9-volt battery. Ideal Birthday present.

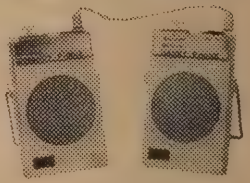
LASKY'S PRICE **42/-** POST FREE with all accessories.

6 Trasnistor pocket radio fully built, in plastic case, 4in. × 2¾in. × 1in. with 2¼in. speaker. Uses single PP3 type battery. Supplied complete with personal earpiece and leather case. Tunable over full medium waveband.

LASKY'S PRICE **79/6** POST FREE complete with all accessories.

FULLY TRANSISTORISED

INTERCOM/BABY ALARM



In 2 compact units, each size 4in. × 2¾in. × 1in. Internal loudspeakers give ample volume. Complete ready for immediate use. Works from PP3 battery.

Complete with battery and sixty feet of connecting wire.

LASKY'S PRICE **69/6**

P. & P. 2/6. Many other types of intercom in stock.

THE SINCLAIR SLIMLINE

The new 2-transistor pocket radio—size only 2¾in. × 1¾in. × 1¼in. Micro alloy transistors and printed circuit. Easy to assemble.

CAN BE BUILT FOR 49/6 All components available separately. P. & P. 1/6 extra.

THE PETIT FULMITER

Designed to replace PP3 9v. battery. Operates direct from 200-250 A.C. Same size as PP3. **18/6.** P. & P. 1/6.

TRANSISTOR AMPLIFIERS

SUB-MINIATURE

NPN-PNP Transformerless. Smallest ever, size 1in. × 1in. × 1in. Output 125 MW from 9 v. batt. Output impedance 30-60 ohms. Freq. range 100 cycles, 25 Kc/s. Uses 3 transistors. Single-ended push-pull output. Fully assembled on printed circuit with full data and instructions.

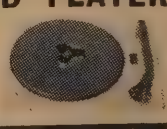
LASKY'S PRICE 29/6 post 2/6.

300 m/w OUTPUT AMPLIFIER

Uses 2 OC71 and 2 OC72. Vol. and tone controls. Fully assembled, size 3 × 2 × 2in., **39/6.**

Post 2/6. Knobs **3/6** extra. Speaker 30 ohm 3 inch. Matched to amplifier **25/-**. Post 1/6.

STAAR KINDER RECORD PLAYER



45 r.p.m. 6 v. Batt. operated. Complete with pick-up fitted crystal cartridge. Size only 7½ × 6in. Fitted auto. stop and start. New and perfect. Suitable for use with both the above amplifiers.

LASKY'S PRICE **49/6** P. & P. 2/6

P.T.O. FOR MORE NEWS

LASKY'S FOR SPEEDY MAIL ORDER SERVICE

5WW—146 FOR FURTHER DETAILS.

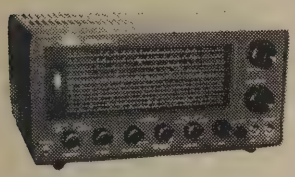
Service in Great Britain

CONSTRUCTORS BARGAINS

HUGE STOCKS OF COMPONENTS, TEST GEAR, ETC.
SPEEDY MAIL ORDER SERVICE

LASKY'S RADIO

MODEL 9R59

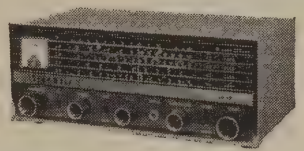


LASKY'S PRICE 40 GNS.
Carriage and Packing Free.
Also available as a kit of parts—write for details.

COMMUNICATION RECEIVERS
BRAND NEW AND UNUSED

Incorporating all the latest technical achievements with many exclusive features. Covers range from 540 Kc/s to 30 Mc/s. Ham Band is provided with a scale for direct reading, and can also be band spread. Auxiliary circuits fitted are automatic noise limiter A.V.C. and M.V.C. Q Multiplier also serves as B.F.O. H.F. stage and two I.F. stages ensure high sensitivity and selectivity. Valve line up 3 × 6BA6, 2 × 6BE6, 2 × 6AV6, 1 × 6Q5 and 5Y3. 2 Aerial Sockets. Stand by position for use with a transmitter. S meter fitted. 200-250 v. A.C. mains. Controls fitted are function switch, volume control, selectivity control, frequency control, band selector, gain control, aerial trimmer AVC/MVC switch, noise limiter switch, band spread tuning and main tuning. Brand new and unused. Boxed with full instruction manual, in attractive steel cabinet, grey crackle finish. Cabinet size 15 × 8 × 10in. Dial 12 × 4in.

MODEL SR40



Covers medium wave band and 1.6-4.4 Mc/s. 4.5-11.0 Mc/s., 11.0-30.0 Mc/s. in separate switched band spread ranges, Controls include B.F.O. Sensitivity, A.N.L., Receiver-Standby Switch, Tone Switch, S-Meter. For 200/250 v. AC/DC. Internal loop and telescopic antennae fitted. Valve line up: 12BE6, 12BA6, 12AV6, 50C5, and metal rectifier. Size 13½ × 8½ × 5½in.

LASKY'S PRICE £24.15.0
Carr. and Ins. 15/-. Instruction manual included.

LOUDSPEAKER ENCLOSURES

The "ACCADIA." A beautifully designed cabinet for a 13 × 8in. speaker and 4in. tweeter. Finished in medium walnut (incl. back panel) size 12in. × 14in. × 27in. high, ¾in. thick. Fully lagged interior. Piano gloss finish.

LASKY'S PRICE £6.19.6
Less Speakers. Carr. and pack. 12/6 extra.

A PAIR OF SPEAKERS and a cross-over capacitor (3 ohms) 52/6 complete. Post 3/6.

The "SHARON" reflex enclosure with 10 × 6in. speaker and 4in. tweeter. Finished semi-matt medium mahogany. Size 11in. × 11in. × 26in. high, ¾in. thick. Fully lagged interior. With 15 ohm speakers and cross-over cap.

LASKY'S PRICE £9.19.6
Complete with speakers. Carr. & pack. 12/6 extra.

NOTE. If you wish to change the impedances of the above speaker systems we can supply a suitable impedance matching transformer at 13/6.

CELLULOSE WADDING For lining the interior of loudspeaker enclosures. Width 36in. Any length cut to nearest 6in.
LASKY'S PRICE 2/11 per sq. yd. and pro-rata. P. & P. extra.

BONDED ACETATE FIBRE as recommended by Wharfedale for acoustic lagging 36in. wide 5/11 per sq. yd. and pro rata. P. & P. extra.

CRYSTAL PICK-UP CARTRIDGES
LOWEST PRICES EVER!

All Complete with Styli L.P. and Standard (and Stereo where shown) fully guaranteed. Standard Fitting will fit most P.U. Arms and Heads. Postage 1/- extra each.

MONO Type C.T.1. By well-known manufacturer With 2 sapphire styli	9 6
Garrard Ceramic G.C.E.4	15 0
Garrard Magnetic T.O.M.2	15 0
Acos GP.59	14 0
Acos GP.65/3	15 0
Acos GP.65/1	17 0
Acos GP.67/1	14 0
STEREO Acostereo 73/1, with 2 sapphires	25 0
Acostereo 73/2, with Diamond LP/Stereo and sapphire Std.	29 6
Collaro type C Turnover, with 2 sapphires	19 11
Collel S.C.I. Turnover, with 2 sapphires	19 11
Collel S.C.I. Turnover, with Diamond L.P./Stereo and sapphire Std.	25 0
Ronette Stereo O.V. Turnover, with 2 sapphires	25 0
Ronette Stereo type 105 and 106 with 2 sapphires	25 0
Ronette Stereo type 105 and 106 with Diamond LP/Stereo and sapphire Std.	35 0

LASKY'S NEW SCOOP!
The "Sixteen" Multirange METER KIT

This outstanding meter was featured by *Practical Wireless*, in the Jan. '64 issue. Lasky's are now able to offer the complete kit of parts as specified by the designer. The "Sixteen" Multirange offers the home constructor and serviceman an instrument that will meet most of his requirements for voltage, current and resistance measurement. There are 16 switched ranges: 9 for voltage measurement, 4 current ranges and 3 resistance ranges. All British components are used throughout. The instrument case is supplied with the meter movement built-in. The two scales are clearly printed in black on white and are very easy to read.

RANGE SPECIFICATION
D.C. volts: 0-2.5-25-50-250-500 at 20,000Ω/V.
A.C. volts: 0-25-50-250-500 at 1,000Ω/V.
D.C. current: 0-50μA, 0-2.5-50-250 mA.
Resistance: 0-2,000Ω, 0-200 kΩ, 0-20 MΩ.
Basic movement: 40 μA f.s.d. moving coil. With universal shunt full scale deflection current is 50 μA.
Size/finish: Black plastic case—3¾ × 5¾ × 1¾in.
Controls: 12 position range switch; Separate slide switch for A.C. volts—D.C. ohms; ohms zero adjustment pot. meter; meter zero. External connections: Two 4 mm. sockets for test lead plugs.
Power requirements: One 15V. and one 1.5V batts.
Complete with all parts and full construction details.

This offer is exclusive to Lasky's Radio!

LASKY'S PRICE £5.19.6 P. & P. 5/-.
Data and circuit available separately 5/-, refunded if all parts bought.

20,000 VALVES IN STOCK
ALL TYPES RADIO AND T.V. ETC.
Send us your requirements for quotation.

DISTLER MINIATURE MOTORS 7/11
6 volt battery operated. P. & P. 2/6.

ADASTRA 3-3 AMPLIFIER

Three watt output, built to the well known 3-3 design, with volume, bass and treble controls. Size 9in. × 7in. × 4in. With attractive escutcheon. Ready built.

LASKY'S PRICE £4.19.6 P. & P. 5/-.

A.K.G. Moving coil stereo headphones. Lightweight with ear pads. 7 GNS. per pair.

FOSTER Stereo moving coil headphones. 79/6 including ear pads. P. & P. 2/6 pair extra.

U.H.F. TUNERS

Only a few available. Complete with P.C.88 and P.C. 86 valves. Fully variable tuning capacitor etc. British manufacture. New and unused. Size 4¼in. × 5½in. × 1¾in. We regret no circuit or data available.

LASKY'S PRICE 59/6 P. & P. 2/6.

T.V. TURRET TUNERS

Famous British make 38 Mc/s. I.F. with a few coils. Uses PCC84 and PCF80 valves. Less valves
LASKY'S PRICE 5/-. P. & P. 2/-. (No data or circuit available)

MULTI TEST METERS

All new and unused and complete with test leads. The finest imported makes, also by AVO, TAYLOR, etc. Write for FREE LIST.

TRANSFILTERS

by BRUSH CRYSTAL Co. Available from stock.

TO—01B	465	kc/s.	± 2	kc/s.
TO—01D	470	kc/s.	± 2	kc/s.
TO—02B	465	kc/s.	± 1	kc/s.
TO—02D	470	kc/s.	± 1	kc/s.
TF—01B	465	kc/s.	± 2	kc/s.
TF—01D	470	kc/s.	± 2	kc/s.

6/6 EACH
P. & .P 6d.

AUTOMATIC CAR AERIALS

Electrically operated automatically extends and retracts at touch of a button. Opens to 72in. Easily fitted. Heavy chrome plated. 12 volt only.
LASKY'S PRICE £6/19/6.

SEND FOR OUR LATEST COMPONENT CATALOGUE
Complete new edition of over 100 pages, 8½ × 5½in., copiously illustrated, packed with money-saving bargains. Invaluable for the "ham" or service man. Price 2/-. Post 6d. Our latest 20-page "Bargain Bulletin" included free (separately by post, 6d.).

PROMPT MAIL ORDER SERVICE *to all parts of the British Isles, the U.S.A. and overseas. Enquiries invited. We also operate the official purchase tax-free plan for overseas visitors—the* PERSONAL EXPORT SCHEME

33 TOTTENHAM COURT ROAD, W.1. 2 mins. Oxford Street. Nearest Station, Goodge Street. MUSeum 2605
Open all day Saturday. Close 1 p.m. Thursday.

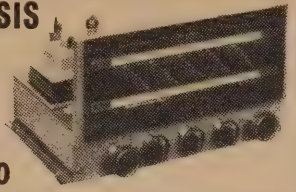
207 EDGWARE ROAD, W.2. Few yards from Praed Street. PADdington 3271/2
Open all day Saturday. Close 1 p.m. Thursday.

ELECTRONICS (FLEET ST.) LTD. 152/3 FLEET STREET, E.C.4. Near Daily Express Building. FLEet St. 2833
Open all day Thurs. Closed 1 p.m. Sats.

PLEASE ADDRESS ALL MAIL ORDERS TO OUR HEAD OFFICE:—207 EDGWARE ROAD, W.2.

LASKY'S RADIO FOR FINEST VALUE and COURTEOUS SERVICE

ARMSTRONG RADIOGRAM CHASSIS



£21.4.0

AF/208 AM/FM RADIOGRAM CHASSIS

- Full VHF Band (87-108 Mc/s.) and Medium Band, 187-570 m.
- 5 watts Output. Perfect quality.
- 15dB Negative Feedback.
- 7 valves.
- Separate Bass and Treble Controls.
- 2 Compensated Pick-up Inputs.
- Frequency Response 30-22,000 c.p.s. ±2dB
- Tape Record and Playback Facilities.
- First Class Continental Reception.

For 3, 7½ and 15 ohm Speakers.

BARGAIN SALE PRICES

New boxed VALVES 90-day guarantee.

OZ4	5/-	6K7G	5/-	EB91	4/-	PCF82	8/-
IR5	6/-	6K8G	5/-	EBC41	8/-	PCL82	10/-
IS5	6/-	6L6G	8/-	EBC81	8/-	PCL84	10/-
IT4	3/-	6N7M	5/-	EBF80	9/-	PL81	10/-
2X2	2/-	6Q7G	6/-	ECH42	9/-	PL83	8/-
3S4	7/-	6SN7	5/-	ECH81	9/-	PY33	15/-
3V4	7/-	6V6G	5/-	ECL80	9/-	PY80	7/-
3Q5	7/-	6X4	5/-	ECL82	10/-	PY81	8/-
5U4	6/-	6X5	6/-	EF85	6/-	PY82	7/-
5Y3	6/-	12AT7	6/-	EF86	10/-	SP41	3/-
5Z4	9/-	12AU7	6/-	EF89	8/-	SP61	3/-
6AC7	4/-	12AX7	7/-	EL32	5/-	U22	7/-
6AM6	4/-	12BH7	7/-	EL84	7/-	UBC41	8/-
6AT6	6/-	12K7	5/-	EY51	9/-	UBC81	9/-
6BA6	7/-	12K8	14/-	EY86	9/-	UBF80	9/-
6BE6	5/-	12Q7	5/-	EZ40	7/-	UCH81	9/-
6BW6	7/-	25Y5G	9/-	EZ80	7/-	UCL82	10/-
6C4	5/-	35L6	9/-	EZ81	7/-	UCL83	12/-
6D6	5/-	35Z4	5/-	HABC80	10-	UF89	9/-
6G6	4/-	954	2/-	HVR2A	5/-	UL41	9/-
6H6	3/-	DAF96	8/-	KT33C	8/-	UY41	7/-
6J5	5/-	DF96	8/-	KT76	8/-	UY85	7/-
6J6	5/-	DK96	8/-	MU14	7/-	UU9	7/-
6J7G	6/-	DL83	8/-	PCC84	8/-	VR150/30	7/-
6K6	5/-	EABC80	8/-	PCF80	8/-	W81	6/-

NEW ELECTROLYTICS FAMOUS MAKES

TUBULAR		TUBULAR		CAN TYPES	
1/350v. ..	2/-	50/350v.	5/6	8/600v.	9/-
2/350v. ..	2/3	100/25v.	2/-	16/600v.	12/-
4/350v. ..	2/3	250/25v.	2/6	16/450v.	5/-
8/450v. ..	2/3	500/12v.	3/-	16 - 16/500v.	7/6
16/450v...	3/-	1,000/12v. ..	3/-	50/450v.	6/6
32/450v...	3/9	5,000/6v. ..	5/-	32 + 32/350	5/-
25/25v. ..	1/9	8+8/450v...	3/6	32 + 32/450	6/-
25/50v. ..	2/-	8+16/450v.	3/9	50 + 50/350	7/-
50/25v. ..	2/-	16+16/450v.	4/3	64+120/350v.	11/6
50/50v. ..	2/-	32+32/350v.	4/6	100+200/275v. ..	12/6

TINNED COPPER WIRE 16 to 22 s.w.g., ½ lb. 3/-.
ENAMEL WIRE ½lb. 16 to 22 s.w.g., 2/9, 24 to 30 s.w.g. 3/6. 32 to 40 s.w.g., 4/6. D.C.C. 28, 34, 36 s.w.g., 3/6 2 oz.

CRYSTAL MIKE INSERTS. High output
Miniature size, 1½in. dia. x ⅝in. 6/6
ACOS STICK MIKE 39-1 ..... 35/-
T.S.L. DE LUXE STICK MIKE 25/-
TELEPHONE CONTACT MIKE... 10/6
GUITAR CONTACT MIKE 15/6

MORSE KEY 4/6; BUZZER 4/6.
VALVE HOLDERS. EA50 6d. B12A, CRT. 1/3. Eng. and Amer. 4, 5, 6 and 7 pin 1/-. Printed circuit B9A, B7G, Int. Oct. 1/-.
MOULDED Int. Oct. or Mazda Oct. 6d.; B7G, B8A, B8G. B9A 9d. B7G with can. 1/6. B9A with can. 1/9. Ceramic EF50, B7G. B9A, Int. Oct. 1/-. B7G, B9A cans. 1/- each. Valve base plugs B7G, B9A, Int. Oct. 2/3.

C.R.T. BOOSTER TRANSFORMERS
For T.V. Tubes having heater Cathode short circuit and for T.V. Tubes with low emission, full instructions. Mains input.
LOW LEAKAGE WINDINGS WITH OPTIONAL 0%, 25% or 50% BOOST ON SECONDARY.
2 V. OR 4 V. OR 6.3 V. OR 10.3 V. OR 13.3 V. (State tube voltage required) ea. **10/6**

HEADPHONES, 2,000 or 4,000 ohms 15/- pair.
HEADPHONES, moving coil 100 ohms 10/- pair.
SWITCH Cleaner Fluid, squirt spout, 4/6 tin.
SPEAKER-FRET. Gold, Green or Maroon Cloth 17×25in., 5/-; 25/35in. 10/-. Tygan various colours, 52in. wide from 10/- ft.; 26in. wide from 5/- ft. Samples 1/-.
Expanded Metal, Gold, 12×12in. 6/-. TYGAN 12×12in. 2/-.

MINIATURE PANEL METERS
Size 1⅝in. sq. Precision jewelled bearings, 2% accuracy, silvered dials, fine pointers, zero adjustment.
0-1mA 27/6; 0-5mA 27/6; 0-300 v. 27/6; 0-50μa 39/6; 0-500μa 32/6. "S" meter 35/-.
CABY MULTIMETER MI 54/-
0-1200 v. A.C.-D.C. Ohms 0-100K, etc.

MAINS TRANSFORMERS
200/250 AC Post 2/- each

STANDARD 250-0-250, 80 mA. 6.3 v., 3.5 a., tapped 4 v. 4 a. Rectifier 6.3 v. 1 a. tapped 5 v. or 4 v. 2 a. 22/6
Ditto 350-0-350 ..... 29/6
MINIATURE 200 v. 20 mA., 6.3 v. 1 a. 10/6
MIDGET 220v. 45 mA. 6.3 v. 2 a. 15/6
SMALL, 250-0-250 v. 45 mA., 6.3 v. 2 a. 17/6
STANDARD 250-0-250 65 mA., 6.3 v. 3.5 a. .. 17/6
HEATER TRANS. 6.3 v. 1½ a. 7/6
Ditto tapped sec., 1.4 v., 2, 3, 4, 5, 6.3 v. 1½ amp. 8/6
HEATER TRANS. 6.3 v. 4 a. 10/6
GENERAL PURPOSE LOW VOLTAGE. Outputs 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30 v. at 2 a. 22/6
AUTO TRANS. 150 w., 0, 115 v. 200, 230, 250 v. 22/6
AUTO TRANS. 500 w. 0, 115, 200, 230, 250 v. 82/6

PARMEKO MAINS TRANSFORMER. Made to special contract, the ratings can safely be doubled. Guaranteed 2 years. Primary 0-110-210-230-250 v. H.T. 300-0-300 v. 50 mA. LT. 6.3 v. 1.8 a. 17/6.
MULLARD "510" MAINS TRANS. TO SPEC. 33/6.

O.P. TRANSFORMERS. Heavy duty 50 mA., 5/6. Small, pentode, 4/6. Miniature 3V4, etc., 5/9. Multi-ratio 7/6. Multi-ratio heavy duty push-pull 10 w., 15/6.
Goodmans heavy duty 10/20 w. 6K push-pull, 30/-.
Estone ultra-linear OT/ML 10 w., Spec. for "510" 45/-. 10 w. matching transformer, 3, 7, 15 ohms, 12/6.
INTERVALVE TRANSFORMERS. 3 : 1, 5 : 1, 9/- each.
L.F. CHOKES 15/10 H., 60/65 mA., 5/-; 10 H. 85 mA., 10/6; 10 H. 120 mA., 12/6; 10 H. 150 mA., 14/-.
FULL WAVE BRIDGE CHARGER RECTIFIERS. 2, 6, or 12V. 1½ a., 8/9; 2 a. 11/3; 4 a. 17/6.
CHARGER TRANSFORMERS. Tapped input 200/250 v., for charging at 2, 6 or 12 v., 1½ a., 15/6; 2 a., 17/6; 4 a., 22/6. Free charger circuit. Ampmeter 0-5a., 10/6.
4 AMP. CAR BATTERY CHARGER with Ammeter Leads. Fuse, Case, etc., for 6 v. or 12 v., 69/6. Ready built.

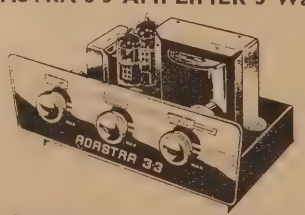
BOOKS (*List S.A.E.*)

"W.W." Radio Valve Data	6/-
High Fidelity Speaker Enclosures	5/-
Valves Transistors, CRT Equivalents	9/6
At a Glance Valves, CRT Equivalents	3/6
Coil Design and Construction	5/-
Transistor Sub-Miniature Receivers	5/-
TV Fault Finding	5/-
Mullard Audio Amplifier Manual	8/6
Radio Valve Guide, Books 1, 2, 3 or 4 ea.	5/-
Transistor Superhet Receivers	7/6
Practical Radio Inside Out	3/6
Master Colour Code	1/6
Practical Tape Recording Handbook	5/-
Coil Design and Construction Manual	5/-
Radio, TV and Electronics Data Book	3/6
International Radio Stations List	2/6
High Fidelity Stereo Gramophone	5/-
Modern Transistor Circuits for Beginners	7/6
Principles of Colour T.V. (Patchett)	16/-
Boys' Book of Crystal Sets	7/6
Stroboscopic Disc 33, 45, 78 r.p.m.	1/-
Realistic High Fidelity (Hartley)	5/-

CRYSTAL DIODES. G.E.C. 2/-; GEX34, 4/-; OA81, 3/-. Crystal Coils HAX, 3/6; HAXL 3/6; DRR2 4/6; DRX1 3/-; CRYSTAL SET BOOKLET 1/-. CRYSTAL SET KIT 12/6. Brimistors CZ1 3/6; CZ2 2/6; CZ3 1/6.

RADIO AND TELEVISION SPARES
All leading makes, volume controls, etc., line output transformers, etc., B.V.A. valves (current and obsolete types). Send S.A.E. for quotation.

ADASTRA 3-3 AMPLIFIER 3 Watts



ADASTRA 3-3 HI-FI AMPLIFIER
READY BUILT, WIRED & TESTED
A.C. only 200-250 V. Valves ECL86 and EZ80. 3 ohms quality output. Mullard tone circuits. Controls: bass boost, treble and volume. Separate engraved front-panel with de luxe finish. Quality mains transformer. Stove enamelled chassis size 6in. x 5in. x 3in. Bargain Price £4/19/6. Details S.A.E.
"*Performs agreeably well.*"
(*The GRAMOPHONE*)

BAKERS 'Selhurst' RADIO

Quality Loudspeakers

CHOOSE THE BEST ESTB. 40 YEARS

12in. Stalwart 15w. 45/13 kc/s, 3 or 15Ω **5 gns.**
12in. Stereo, foam suspension, 15 ohms. **7 gns.**
12in. Standard H.D. 20 w. 40-14,500 c.p.s. **7 gns.**
12in. De Luxe foam, 15 w. 25-17,000 c.p.s. 15,000 Lines, Bass Res. 32-38. **9 gns.**
12in. Bass 25 w. 20-18,000 c.p.s. **12 gns.**
12in. Ultra Twelve, 20 c.p.s. to 25 kc/s. **16 gns.**
15in. Baker Bass Auditorium 35 w. Mk. II. 17,000 Lines, Ideal for Bass Guitars. **18 gns.**
Stalwart Portable Enclosure 18" x 13" x 8" **£3.**

LOUDSPEAKERS. PM 3 OHM FAMOUS MAKES.
2½in., 3in., 4in., 5in., 6in. × 4in. 15/6 each; 8in. 17/6; 6½in., 16/6; 10in. 30/-; 12in. 30/-; (15 ohms 35/-). 10in. × 6in. 22/6; 8"×5", 9"×6", 21/-.
STENTORIAN Tweeter. T359 5 or 15Ω 30/-; Crossover CX3000. 30/-: 10in. HF1012. 87/6; 8in. HF812 72/6.
TWIN GANG CONDENSERS "0-0" Transistor 208pF and 176 pF, with trimmers and screen 10/6 each; 365 pF. miniature 1⅝ × 1⅝in. × 1⅞in. 10/-; 500 pF standard with trimmers, 9/-; midget, 7/6; midget with trimmers, 9/-; 500 pF slow motion drive, standard or midget, 9/-. Small 3 gang, 500 pF., 17/6. Single "0" 365 pF, 7/6.
SHORT WAVE. Single 10 pF, 25pF, 50 pF, 75 pF, 100pF, 160pF. 5/6 each. Can be ganged together. Couplers 9d. each.
TUNING AND REACTION CONDENSERS. 100pF., 300pF., 500pF., 3/6 each. solid dielectric.
CONDENSERS. 0.001 mfd., 7kV. T.C.C. 5/6; ditto 20 kV. 9/6; 0.1 mfd. 7 kV., 9/6; 100 pF. to 500pF. Micas, 6d. Tubular 500 v. 0.001 to 0.05 9d.; 0.1 1/-; 0.25 1/6; 0.1/350 v. 9d.; 0.5/350 v., 1/9; 0.01/2,000 v., 1/9; 0.1/2,000 v. 3/6.
CERAMIC CONDENSERS. 500 v. 1pF. to 0.01 mfd., 9d. High voltage pulse ceramics, 100pF., etc., 12kv., 2/6.
SILVER MICA. 10% 5 to 500pF., 9d.; 600 to 3,000pF. 1/-; close tolerance (plus or minus 1pF), 2.2 to 47pF., 1/-; ditto 1% 50 to 815pF, 1/-; 1,000 to 5,000pF., 1/9.

465-470 Kc/s. SIGNAL GENERATOR
Price 10/6. Ready made with valve 1S5. POCKET SIZE 2½in. × 4½in. × 1in. Only one resistor to change. Full instructions supplied. Battery 8/6. Details free.

WAVE-CHANGE SWITCHES
2 p. 2-way, or 2 p. 6-way, long spindle 3/6
3 p. 4-way, or 1 p. 12-way, long spindle 3/6
4 p. 2-way, or 4 p. 3-way long spindle 3/6
8 p. 4-way, 2 wafer long spindle 6/6
Wavechange "MAKITS" Wafers available; 1 p. 12-way, 2 p. 6-way, 3 p. 4-way, 4 p. 3-way, 6 p. 2-way. Prices include click spindles, adjustable stops, etc.
1 wafer, 8/6; 2 wafer, 12/6; 3 wafer, 16/-. Additional wafers up to 12. 3/6 each.
TOGGLE SWITCHES. s.p., 2/-; d.p., 3/6, d.p.d.t., 4/-. Rotary Toggles, s.p., 3/6; d.p. 4/6. Min. Slide D.P. 3/6.
JACKS. English open-circuit 2/6, closed-circuit 4/6. Grundig type 3-pin 1/3; Grundig Lead Type 3/6. Phono Plugs 1/-. Sockets 6d. Banana Plugs 1/-. Sockets 1/-.
JACK PLUGS 3/-. Screened 4/-, Grundig 3-pin 3/6.
BULGIN NON-REVERSIBLE PLUGS and SOCKETS. P74 2-pin 4/3; P73 3-pin 4/6; P194 6-pin 6/6.
P360 3-pin 4/-; Mains selector panel with plug 1/-.

MARTIN TAPE PRE-AMPLIFIERS
(PLAY-BACK THROUGH YOUR OWN HI-FI)
FOR 2 TRACK BSR DECKS 8 GNS
FOR 2 TRACK COLLARO DECKS 8 GNS
MARTIN COMPLETE RECORDING AND PLAYBACK AMPLIFIERS
FOR 2 TRACK BSR £8/8/-. COLLARO £11/11/-.
TAPE DECKS
BSR 2-Track £6/15/-. Collaro-2 Track £10/10/-.

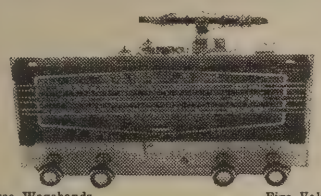
48-HOUR RETURN OF POST MAIL ORDER SERVICE

RADIO COMPONENT

Our written guarantee with every purchase. Buses 133 or 68 pass door S.R. Stn. Selhurst

FOR — IMMEDIATE — DESPATCH — PHONE — US — TODAY

1964 RADIOGRAM CHASSIS



Three Wavebands — Five Valves
S.W. 16 m.-50 m. — Latest Mullard
M.W. 200 m.-500 m. — ECH81, EF89, EBC81,
L.W. 800 m.-2,000 m. — EL84, EZ80

12-month guarantee. A.C. 200-250 v. 4-way switch. Short-Medium-Long-Gram. Ferrite Aerial. A.V.C. and Negative Feedback. 5 watts 3 ohm. Chassis 13½in. × 7in. high × 5½in. deep. Glass dial size 13in. × 4in. horizontal wording. Two Pilot Lamps. Four Knobs. Aligned and calibrated. Chassis isolated from mains.

BRAND NEW £9.15.6 Carr. 4/6.

Matched Speakers 8in. 17/6; 10in. 25/-; 12in. 30/-.

Volume Controls

Long spindles. Midget
5K ohms to 2 Meg.
L/S 3/-. D.P. 4/6.

Stereo L/S 10/6. D.P. 14/6.
Linear or Log Tracks.

80 ohm CABLE Coax

Semi-air spaced 6d. yd.

Fringe Quality, Air spaced.
Ideal 625 lines 1/6 yd.

CAR AERIALS PLUGS 1/6. Ditto sockets 1/3.
COAXIAL PLUG 1/-. TRIPLEXERS. Bands I, II, III 12/6.
PANEL SOCKETS 1/-. LEAD SOCKET 2/-.
COAX. OUTLET BOXES, SURFACE OR FLUSH 4/-.
BALANCED TWIN FEEDER 6d. yd., 80 or 300 ohms.
TWIN SCREENED FEEDER 1/-. 80 ohms.
EXTENSION SPKR. CONTROL, 10 ohms 3/-. 25 ohms 6/6.
TELESCOPIC CHROME AERIALS. 13in. extending to 43in. 8/6 each.
RESISTORS. Preferred values. 10 ohms to 10 meg. ¼ w., ½ w., 4d.; 1 w., 6d.; 1½ w., 8d.; 2 w., 1/-.
HIGH STABILITY. ½ w. 1% 2/-. Preferred values, 10 ohms to 10 meg. Ditto 5%, 10 ohms to 22 meg., 9d.

5 watt, 10 watt, 15 watt — WIRE-WOUND RESISTORS 10 ohms-10,000 ohms — 1/3, 1/6, 2/-
12.5K. to 47 K. 10 w. 3/-

I.F. TRANSFORMERS 7/6 pair
465 kc/s. Slug Tuning Miniature Can. 2 × 1 × 1in.
High Q and good band width. Data sheet supplied.
Standard size Weyrad 1⅛in. sq. × 3½in., 10/6 pair.

WIRE-WOUND Pots. 3 WATT. Pre-set Min. TV Type. All values 10 ohms to 25K, 3/- ea.; 30K, 4/-; Carbon 30K to 2 meg., 3/-.	WIRE-WOUND 4-WATT STANDARD SIZE POTS. LONG SPINDLE VALUES 50 OHMS to 50K, 6/6; 100K, 7/6.

TRIMMERS. Compression ceramic 30, 50, 70 pF, 9d.; 100 pF, 150 pF, 1/3; 250 pF, 1/6; 600 pF, 750 pF, 1/9; Philips 0 to 10 pF., 3 to 30 pF., 1/- each. T.V. etc. 1000 pF. with knob. 2/-; RADIO SCREWDRIVER, 5in., 6d.
Bulgin Test Prods 2/9 ea. Neosid Trimming tools 1/9.
NEON MAINS TESTER-SCREWDRIVER. 5/-.
SOLDER MULTICORE 4d. yd. SAVBIT DISPENSER 2/6.

HIGH GAIN TV PRE-AMPLIFIER BAND 1 B.B.C.
Tunable channels 1 to 5. Gain 18 dB. ECC84 valve. Kit price 29/6 or 49/6 with power pack. Details 6d. (PCC84 valves if preferred).
BAND III I.T.A.—same price.
Tunable channels 8 to 13. Gain 17 dB.
Set of coils and circuit only, 9/6. Band I or III.

PAXOLIN PANELS. ⅛in. × 10in. × 8in., 2/-.
RECTIFIERS. RM1 5/-; RM2 6/-; RM3 8/-; RM4 10/-; RM5 10/-; 14A100 10/-; 14A116 10/-; K3/25 5/-.
MINIATURE CONTACT COOLED RECTIFIERS. 250 v. 50 mA., 7/6; 250 v. 60 mA., 8/6; 250 v. 85 mA., 9/6; 200 mA., 21/-; 300 mA., 27/6; Full Wave Bridge 250 v. 75 mA., 10/-; 120 mA., 15/-. Silicon 250 v. 450 mA., 10/-.
SELENIUM RECT. Popular type. 300 v. 85 mA., 5/-.
OSMOR MIDGET "Q" type, adj. dust core, from 4/- each.
TELETRON D.W.R. L. and Med. T.R.F. reaction, 4/-. Medium only DR. 4/-. COILS. Wearite "P" type, 4/- each.
FERRITE AERIALS (VALVE) M. 8/9; M.L., 12/6.
FERRITE ROD AERIALS. L. and M. for transistor circuits OSMOR 10/- each. WEYRAD 12/6 each.
FERRITE RODS 8" × ⅜ 3/-; 6" × ⅜" 3/-; 6" × ⅝" 3/-.

QMAX CHASSIS CUTTER

The cutter consists of four parts; a dia. a punch, an Allen screw and key.

⅜in.	14/6	1⅛in.	18/-	2in.	34/3
½in.	14/6	1¼in.	18/6	2⅜in.	37/9
¾in.	15/6	1 5/16in.	20/-	2½in.	44/9
⅞in.	15/9	1⅜in.	20/-	1in. sq.	31/6
1in.	16/-	1½in.	20/6	1¼in. sq.	28/-
1 1/16in.	18/-	1⅝in.	22/6		

ALUMINIUM CHASSIS. 18 s.w.g. Plain, undrilled, 4 sides, riveted corners, lattice fixing holes, 2½in. sides, 7in. × 4in., 4/6; 9in. × 7in., 5/9; 11in. × 7in., 6/9; 13in. × 9in., 8/6; 14in. × 11in., 10/6; 15in. × 14in., 12/6.
ALUMINIUM PANELS. 18 s.w.g. 12in. × 12in., 4/6; 14in. × 9in., 4/-; 12in. × 8in., 3/-; 1 pin × 7in., 2/-; 8in. 6in., 2/-; 6in. × 4in., 1/6.

H.F. CHOKES, all wave, 2/6. Osmor QC1, 6/9.
T.R.F. COILS A/HF, 7/-; pair HAX 3/6; HAXL 3/6.
REPANCO DRB2 4/6. DRX1 3/-. Purple Cores ⅛in. 6d.
ALADDIN FORMERS and cores. ¼in. 8d., ⅜in., 10d., 0.3in. FORMERS 5937 or 8 and cans TV1 or 2, ¾in. sq. × ⅝in. or ¾in. sq. × 1¼in., 2/- with cores.
SLOW MOTION DRIVES. Epicyclic ratio 6-1, 4/3.
SOLON IRON 25 w. 200 v. or 230 v., 24/-. 65 w. 29/-.
A.N.T.E.X. PRECISION sub-miniature iron. 200 or 240 v. 29/6. Stands for A.N.T.E.X. irons 12/6 extra.
Spares in stock for above irons.

EAGLE 4 TRANSISTOR PUSH-PULL AUDIO AMPLIFIER

Size 4 × 1¾ × ⅞in.

Powerful, ready built miniature push-pull amplifier with output transformer, 4 transistors. Ideal for use with record players, intercoms., or "BABY ALARM." Complete with full instructions and circuit.

PRICE **47/6** 9 v. Batt. 2/6. 2½in. SPEAKERS 15/-

MAINS DROPPERS. Midget. With adj. sliders.
0.3A 1,000 ohms, 5/-. 0.15A 1,500 ohms, 5/-.
0.2A 1,200 ohms, 5/-. 0.1A 2,000 ohms, 5/-.

BARGAIN SINGLE PLAYER KIT 200/250 v. A.C.

£5.15.0 (less cabinet) post 5/-

WITH 2-STAGE AMPLIFIER 3-WATT
2 VALVES UCL82, UY85,
HIGH-FLUX 5in. SPEAKER,
4-SPEED E.M.I. TURNTABLE,
16, 33, 45, 78 R.P.M. ACOS
CRYSTAL PICK-UP FOR L.P. STD.
RECORDS, 7in., 10in., 12in.
Cut out Mounting board 12¾ × 9¾in.

ARDENTE TRANSISTOR TRANSFORMERS
D3035, 7.3 CT:1 Push Pull to 3 ohms for OC72..... 11/-
D3034, 1.75:1 C.T. Push Pull Driver for OC72..... 11/-
D3058, 11.5:1 Output to 3 ohms for OC72 etc..... 11/-
D167, 18.2:1 Output to 3 ohms for OC72, etc..... 12/-
D239, 4.5:1 Driver, ¾in. × ¾in. × ¾in. 11/6
D240, 8.5:1 Driver, ¾in. × ¾in. × ¾in. 11/6
ARDENTE TRANSISTOR VOLUME CONTROLS
VC1545, 5K with switch, 5/3. VC1760, 5K with switch 10/6.
DEAF AID EARPIECE Xtal or magnetic, 7/6.
SUB-MIN. JACK and PLUG, 3/6 pair.
MIKE TRANSFORMERS 50:1, 3/9.
P.V.C. CONN. WIRE, single or stranded, 2d. yd.
TWIN P.V.C. FLEX, 2 amp., 5d. yd. 3-core 1/-.
SLEEVING 1 or 2 mm., 2d.; 4 mm. 3d.; 6 mm., 5d. yd.
Bib Cutters 3/6. Insulated Side Cutters, 8/6.
Panel mounting fuse-holders 2/-. Fuses 60 mA. to 5a., 6d.

FAMOUS MAKES PLASTIC RECORDING TAPE

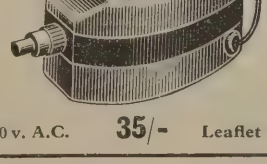
Double Play	7in. reel, 2,400ft. 42/-	
	5in. reel, 1,200ft. 25/-	
Long Play	7in. reel, 1,800ft. 22/6	
	5½in. reel, 1,200ft. 17/6	
	5in. reel, 900ft. 15/-	
Standard	7in. reel, 1,200ft. 17/6	
	5in. reel, 600ft. 11/6	

Spare Spools
3in. .. 1/6
4in. .. 2/-
5in. .. 2/-
5½in. .. 2/-
7in. .. 2/6
Leader Tape 4/6
Splicer Tape 3/-

"EASYSPLICE" Tape Splicer 5/-.

Screws 1 gross assorted 6BA. 6/6, 4BA. 8/6.
Nuts and Washers 1 gross ea. 6BA 6/6, 4BA 8/6.

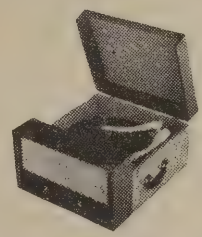
THE "INSTANT" BULK TAPE ERASER AND RECORDING HEAD DEMAGNETIZER



200/250 v. A.C. **35/-** Leaflet S.A.E.

BUILD YOUR OWN RECORD PLAYER

FROM £9.19.6 AND SAVE POUNDS



4 Speed Autochange or Single Player units supplied with Brand New 2-tone Portable Cabinets 17 × 15 × 8½in. Strong carrying handle, gilt finish, clips and hinges. As used by Famous Make for 20 gns. models. Ready cut-out motor board 14 × 13in. Front baffle with 7 × 4in. high flux loudspeaker and 3 watt 2 valve UY85, UCL82 2-stage amplifier ready built on metal chassis 12 × 3 × 2½in. Quality 3 ohm output transformer, low hum level circuit. Volume and Tone controls, 3-core safety mains lead. All items fit together perfectly. Special instructions enable assembly in 30 minutes, only 5 wires to join! 12 months' written guarantee. Available separately or package deals as below:

AUTOCHANGE KITS Complete—as above.		
B.S.R. Monarch UA14	£11/10/-	P.P. 5/-
Garrard Autoslim	£12/18/-	P.P. 5/-
SINGLE PLAYER KITS Complete—as above.		
E.M.I. Junior	£9/19/6	P.P. 5/-
E.M.I. auto stop/start	£11/5/-	P.P. 5/-
OR SEPARATELY		
Cabinet with cut-out board	£3/9/6	P.P. 3/6
Amplifier with 7 × 4in. speaker	£3/17/6	P.P. 3/6
AUTOCHANGERS		
B.S.R. UA14	£5/19/6	P.P. 3/6
B.S.R. U.A.15/16	£6/17/6	P.P. 3/6
Garrard Autoslim	£6/17/6	P.P. 3/6
SINGLE PLAYERS		
E.M.I. auto stop/start	£5/10/-	P.P. 3/6
E.M.I. Junior	£3/7/6	P.P. 3/6
TRANSCRIPTION UNITS		
Garrard 4HF	£16/10/-	P.P. 5/-
Philips AG1016	£12/5/-	P.P. 5/-
Garrard AT6	£11/10/-	P.P. 5/-

BARGAIN Stereo/Mono
B.S.R. Autochange UA12 .... £7/10/- P.P. 3/6
Replacement sapphire styli available from 5/3
Replacement Xtals from 15/-; Stereo from 31/6

NEW MULLARD TRANSISTORS

OC71 6/-, OC72 7/6, OC81D 7/6, OC81 7/6, AF115 10/6, AF114 11/-, OC44 8/9, OC45 8/6 OC171 10/6, AF117 9/6.
Sub Miniature Condensers. 0.1 mFd, 30 v., 1/3. 1, 2, 4, 5, 8, 16, 25, 30, 50, 100 mFd., 12 volt 2/6 each.
Transistor Holders 1/3.

"6+1" TRANSISTOR RADIO

First-class components to make a 6-transistor 2-wave band superhet chassis. Ideal for portable or table radio. All parts including BVA transistors, ferrite aerial, printed circuit. 8½in. × 2½in., but EXCLUDING speaker and cabinet, 35 ohms output. Simple instructions 1/6 (free with kit)
Speakers 35 ohm., 7/4in., 21/-. **£4.5.0**
5in., 17/6; 8½in., 15/6.

WEYRAD

TRANSISTOR SUPERHET TRANSFORMERS, COILS PRINTED CIRCUIT AND FERRITE ROD AERIAL

Long and Medium Wave Aerial—RA2W with CAR AERIAL COIL. 6in. rod, ⅜in. dia., 208 pF. tuning	12/6
Oscillator Coil, P50/1AC, 176 pF tuning	5/4
1st and 2nd I.F. Transformers—P50/2CC, 470 Kc/s. ⅜in. diameter by ½in. high, each	5/7
3rd I.F. P50/3CC diode detector	6/-
Driver Transformer—LFDT4	9/6
Printed Circuit—PCA1. 2½in. × 8½in. Drilled and printed	9/6
Jackson "00" gang 208+176 pF. with trimmers	10/6
Volume Control 5K, D.P.	4/6
35 ohm Speakers 3½in. 15/6. 5in. 17/6. 7×4in.	21/-
Wavechange Switch	3/6
Set of 6 Mullard Transistors and diode	42/6
Constructor's Booklet with full details	2/-
3 ohm Output Transformer OPT1	10/6

B.B.C. 2 TRANSISTOR + DIODE—22/6
M.W. and L.W. Radio Kit. Earpiece 7/6; Battery 2/3 Circuit and Details 6d. Real performance.

SINCLAIR "SLIMLINE" 49/6.
2 Transistor plus 2 Diodes. Med. wave kit. Cabinet 3 × 1¾ × ¾in. Includes earphone, printed circuit, Ferrite Rod. Guaranteed no aerial required. Batt. 3/6

EXPERTS ANSWER ALL ENQUIRIES

SPECIALISTS

48-Hour Mail Order

337 WHITEHORSE ROAD
WEST CROYDON Telephone THO 1655

P. & P. charge 1/-, Full list, 1/-, C.O.D. 2/- extra. (Export welcome. Send remittance and extra postage, no C.O.D.)

BRAND NEW EX-GOVERNMENT METERS

0-160 volt A.C./D.C. moving iron voltmeters, magnificent instruments in polished wooden cases with leather carrying handle. 6in. mirror scale with knife edge pointer. **55/-**. Ditto 8in. scale, **59/6**. Both carriage 5/-.
0-200 amp. A.C. meters, moving iron by Nalder Thompson, 6in. iron case, panel mounting **55/-**, post 4/- (external shunt required).
0-500 volt A.C. meters, moving iron, 6in. iron case, panel mounting, **70/-**, post 4/-.
0-15 amp. A.C. moving iron meter, 6in. dial, iron case, **25/-**, post 4/-.
0-10 volt A.C. meter, 2in. moving coil movement with rectifier (resistance 4,000 ohms), **17/6**, post 2/6.
Frequency Meters 900-1,300 c/s., **30/-**, post 4/-.
0-12 amp. D.C. meters, 2in. flange mounting, **17/6**. post 2/6.
0-250 amp. D.C. meter, moving coil, 6in. scale, wooden case, **35/-**, post 4/-.
0-500 volt D.C. meter, moving coil, 6in., panel mounting **55/-**, post 4/-.
0-01, 0-1, 0-10 amp. 3-range D.C. ammeter, moving coil, portable, 3½in., in leather case, **25/-**, post 2/6.
0-150 volts D.C. moving coil meters, 2½in. resistance 1,000 ohms per volt (F.S.D. only 1 m/a.), **25/-**, post 2/6.
0-200 amp. "Tong Test" ampmeters, D.C. leads, D.C. current by induction without breaking circuit **55/-**, post 4/-.
0-50 amp. D.C. moving coil, 2½in., less shunt, panel mounting, **10/-**, post 2/6.
150-0-150 m/a., 30-0-30 m/a., moving coil meters, dual range, 2½in., panel mounting, **7/6**, post 2/6.
0-500 Micro Ampmeter, 2in. moving coil, scaled 0-15 volts and 0-600 volts D.C., **15/-**, post 2/6.
0-250 micro amp. D.C. moving coil meters, 2½in. panel mounting, **20/-**, post 2/6.
Multi range portable test meters, 1,000 ohms per volt (F.S.D. only 1 m/a.) 19 ranges, up to 5,000 A.C. or D.C., complete with prods in wooden carrying case and instructions, **£4/5/-**, post 4/-.
0-50 D.C. ammeter 6in. moving iron, flange mounting, iron case by W. O. Prescott, **25/-**, post 4/-.
0-80 A.C. ammeter 4in. moving iron, flange mounting, iron case, Crompton Parkinson, **35/-**, post 4/-.
All goods supplied on 14 days' approval against cash. subject to purchaser agreeing to pay carriage both ways in event of return for any reason.

R. SANKEY
REGAL CINEMA, ATHERSTONE, WARWICKS
Telephone: Atherstone 2220/3210

5WW—148 FOR FURTHER DETAILS.

RELAYS

LARGE STOCKS ★ KEEN PRICES ★ QUICK DELIVERIES

FROM STOCK OR BUILT TO SPECIFICATION, COIL VALUES—UP TO 22,000 OHMS SINGLE — TWIN — SLUGGED
BUILD UPS — MAKES, BREAKS, C/O's ETC.
SILVER — PLATINUM — HEAVY DUTY
COMPONENT PARTS SOLD SEPARATELY.
Write us your requirements

P.O. TYPES
3000 & 600
G.E.C.
SIEMENS
S.T.C.
SEALED & HIGH SPEED

SPECIAL OFFER—TO CLEAR—
3000 TYPE ONLY
Complete tested relays—ex Unit—Immediate delivery.
Coil values up to 6,500 ohms.
1 C/O ... **7/6** 2 C/O **9/-**
4 C/O ..... **10/6** 6 C/O **12/6**
Postage 1/6.
Also many other combinations of contacts.
N.B. Special Prices for over 100 lots.
Over 10,000 type 3000 coils to clear at special prices.

Stocks still available of Rotary Transformers and Dynamotors from **27/6**, p.p.4/-, **Sliding Resistances** 0.4 ohms, 250 watts to carry 25 amps., worm drive: 1 ohm. 125 watts to carry 12 amps., slider type (**12/6** each, 5/- post). **Loud-Hailer Diaphragms** (**5/-** each, 1/- post). **Belling Fuseholders,** ex unit, one hole fixing (1/- each, 6d. post). **R.C.A. Transmitter Transformers,** Type 900763-501; class—modulation, primary 10,400 ohms, secondary 4,300 ohms, new and boxed (**75/-** each, carriage extra), etc., etc.

DEPENDABLE RADIO SUPPLIES LTD.
12A TOTTENHAM STREET, LONDON, W.1
Telephone: LAN 7391/2
WRITE — CALL — PHONE

5WW—150 FOR FURTHER DETAILS.

The Kit you have been waiting for!

Enhance the appearance. Improve the performance of your favourite transistor set by building it on a printed circuit chassis of your own design from parts you already have.

PRINTED CIRCUIT KIT

Price 5/-. P. & P. 1/-.

CONTENTS: (1) 1/16in. Copper laminate board 4½" × 2½".
(2) **All chemicals** to etch a chassis for a pocket loudspeaker receiver, or any circuit described below.
(3) **Plastic case** for the above (4½in. × 2½in. × 1in.).
(4) **Instruction booklet "Printed circuits for amateurs."**
(5) **10 suggested circuits and layout diagrams** to suit this kit and your components, listed below.
(1) **Sensitive pocket loudspeaker Reflex.**
(2) **Record-player/intercom amplifier.**
(3) **Miniature match-box receiver.**
(4) **Sub-miniature Wrist-watch radio.**
(5) **"Solar Battery" Portable Receiver.**
(6) **Selective crystal set with Loudspeaker.**
(7) **Carrier Power Conversion Receiver.**
(8) **Metal Detector—Treasure Locator.**
(9) **Simple Radio Control Receiver.**
(10) **Remote Control** of Models by induction.

All electronic components available separately for these circuits. Extra copper laminate 1d per sq. inch. Add for postage and packing, 1/- minimum.

"LITON PHOTOELECTRIC CONSTRUCTION MANUAL"

for the amateur constructor

2nd Edition now available. Send 1/- in stamps please. Customers whose orders for this book we were unable to supply earlier please re-order now, while stocks last.
CONTENTS: 4 Burglar alarms for mains and battery **operation. Light-beam modulator. Projector Stabilizer. Photoelectric Counter. Garage Door Opener. Light Saver. Customer Announcer,** etc. **Photo Cells and Photo Transistors.** A mine of practical information for the home experimenter. **26 diagrams and illustrations.** To avoid disappointment send for it to-day. All units available ready built or in kit form. Details and Prices in Manual.

Battery Alarm Kit 65/-. MAINS KIT £5/10/-.

"ST. JOHN'S RADIO," Mail Order Dept.,
3, Jews Row, S.W.18 Callers to **354 York Road, S.W.18.** Phone: VAN 8822

WANTED EX-W.D.

Photographic paper, films—16mm & 35mm. Also equipment. Details and prices to clear to:—

D.P.S. LTD.,
224 Edgware Road,
London, W.2
Phone: AMBassador 4427/8

5WW—149 FOR FURTHER DETAILS.

Audix
SOUND SYSTEMS
AUDIO EQUIPMENT MANUFACTURES
STANSTED, ESSEX.
Phone: STANSTED 3132

5WW—151 FOR FURTHER DETAILS.

CABINETS • CASES CHASSIS

Anything in metal. "ONE OFFS" a pleasure
Send your drawings for quote
Stove enamelled in any professional finish

MOSS, WATSON
40 MOUNT PLEASANT STREET, OLDHAM LANCS. *MAIN 9400*

5WW—152 FOR FURTHER DETAILS.

SUPPLIED COMPLETE WITH VALVES & CRYSTALS
Details & Prices of all Accessories supplied on request.

LATEST miniature WALKIE TALKIE

"88" set—Produced to exacting specifications by leading manufacturers E. K. Cole & Co

Only **£10.0.0** EACH

This Transmitter/Receiver weighs only 5½lb. (approx.) and measures 3½in. x 5½in. x 9½in.

It is a 4 frequency channel set, **crystal controlled** 38-40/40-42 Mc/s., and operates from a Standard Dry Battery—H.T./L.T. 90 v./1.5 v. (i.e. Vidor L5537). 14 of the current series of B7G valves are employed 1-3A4, 6-1L4, 4-1T4, 1-1S5, 2-1A3. Each set in first class condition. Special quotations for quantities.

All items from Ex-stock

AERIAL MASTS

20FT. TELESCOPIC MAST. NEW all steel tubular 4 section Masts suitable for Roof or Wall fixing, as well as Base location, can be extended to full height or locked at any position by special Roller Cam locking rings. Drilled plate at the top allows for guying if necessary. Bottom section approximately 1½in. diameter. Copperised and Sprayed finish. Weight 16 lb.

Price £5.0.0 Carr. 7/6.

LIMITED QUANTITY
36ft. BRASS TELESCOPIC MAST

COMPLETE WITH BUILT-IN HAND WINDING WINCH FOR EASY RAPID EXTENSION. Finest quality. Non-rusting. Bottom section 2½in. dia. Winds down to 9ft. One of the best masts ever produced

Price £35.0.0 Carr. 30/-.

Irongate (M.O.) LTD
Dept. (WW4) IRONGATE WHARF RD., PRAED ST., LONDON W.2
PADDINGTON 2233/4

5WW—153 FOR FURTHER DETAILS.

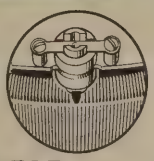
NEW TEST EQUIPMENT

WORLD FAMOUS "SLIDUP" VARIABLE TRANSFORMERS

Output: 0-260 v.
Input: 230 v. A.C. 50/60~.

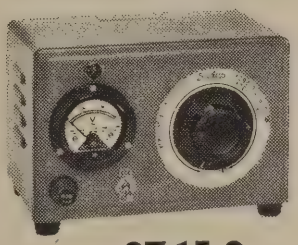
A SHROUDED FULLY VARIABLE TRANSFORMER FOR BENCH OR PANEL MOUNTING.

2.5 Amp. ...	£5.17.6
5 Amp. ...	£9. 0.0
10 Amp. ...	£18. 5.0
20 Amp. ...	£32. 10.0



Inset shows latest type brush gear providing 1 volt variation.

PORTABLE VARIABLE A.C. POWER SUPPLY UNIT



Output: 0-260 v. 1½ amps. *Input:* 230 v. A.C. 50/60~. Unit fitted with fuse, voltmeter, safety indicator, on-off switch and lead.

PRICE £7.15.0

HEAVY DUTY 20 AMP. L.T. SUPPLY UNIT

by S.T.C.

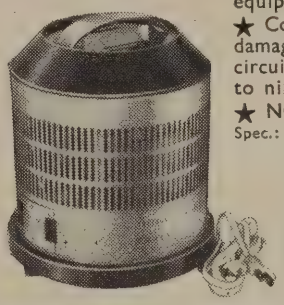
Normal cost over £100. Essential equipment for Electronic Engineering. Research Laboratories, Schools. Ideal for battery charging, etc. Guaranteed for 20 amps.

Output: D.C. variable up to 20 amps. and 24 v. or trickle charge 125/350/700 m. A/H. *Input:* A.C. 100/260 v. 45/65 cycles. *Size:* 16 x 24 x 32in. high. In attractive grey cabinet.

ONLY £27.10.0

CONSTANT VOLTAGE TRANSFORMER

DUAL VOLTAGE MAINS STABILISER provides perfectly stabilized constant voltage for all laboratory equipment.



★ Completely protected from damage if appliance is short-circuited, output voltage reduces to nil.

★ NO MOVING PARTS.

Spec.: *Input:* 180-260 v. A.C. & 85-125 v. A.C. *Output:* 240 v. A.C. and 115 v. A.C.—50/60 cycles. *Capacity:* 250 v. A. *Accuracy:* ±1%. *Size:* 8 x 8in. *Weight:* 21lb. Complete with lead and plugs, in attractive vented metal case with leather handle.

£11.10.0

IMMEDIATE DELIVERY

ALL ITEMS FULLY GUARANTEED—CARRIAGE FREE

TRANSISTORIZED MEGOHMETER

BATTERY OPERATED. 500 v.—1,000 MEGOHMS.

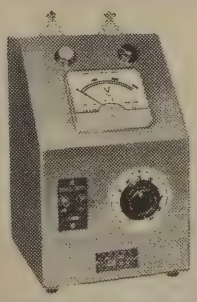
This most advanced insulation and continuity tester incorporates these outstanding advantages:

★ One-handed push-button operation.
★ 4in. A.C.-D.C. Voltmeter with fine Zero adjustment.
★ Stable and accurate readings.
★ Easy-to-read scaling.
★ Metal case 7in. x 5in. x 3in.

Complete with probes and carrying case ONLY **22 gns.**

Model MT-500. 500 v. 0-500 megohms insulation Tester. Mains operated. Suitable for bench use. Complete with lead. **25 gns.**

VARIABLE HIGH-VOLTAGE UNIT



★ ***Range:*** Infinitely variable up to 3,000 volts and can be accurately set. 0.1 amp.
★ Entirely suitable for continuous testing.
★ Built-in Automatic safety cut-out.

Input: Mains voltage.

Robustly constructed for bench use with 4½in. x 4in. modern styled meter, placed at an easy to read angle. Complete with input and test leads with clips.

Model T30, 0-3,000 v. A.C. £32
Model T50, 0-5,000 v. A.C. £40

TRANSISTOR TESTER

Model AT-1 **£9.17.6**

MEASUREMENT RANGES:

Ico (Icbo) and the reverse currenr of diodes.
PNP & NPN—0~50μA (1μA per scale)
POWER—0~1mA (20μA per scale)
β5-200 (5 per scale)
Bias current—
(1mA on PNP & NPN)
(5mA on POWER)
α0.9-0.995 (from $\beta=\frac{\alpha}{1-\alpha}$)

Terminals: Spring Sockets and Screw Terminals.
Meter: 4in. 50μA moving coil.
Size and Weight: 7 x 5 x 3in. 2½ lb.
Powered by pen-cells.

Irongate (M.O.) LTD

Dept. (WW4) IRONGATE WHARF RD., PRAED ST., LONDON, W.2
PADDINGTON 2233/4

5WW—154 FOR FURTHER DETAILS.

BENTLEY ACOUSTIC CORPORATION LTD.

38 CHALCOT ROAD, CHALK FARM, LONDON, N.W.1

THE VALVE SPECIALISTS *Telephone PRIMROSE 5090*

ALL GOODS LISTED BELOW IN STOCK

OA2	4/6	9BW6	9/6	DF97	10/-	EL820	16/4	R16	29/-
OB2	6/-	10C1	9/3	DH76	3/6	EL822	18/6	R18	9/6
OZ4GT	4/3	10C2	12/3	DK40	18/8	ELL80	20/5	R19	6/6
1A5	5/-	10D2	10/6	DK92	6/9	EM4	17/9	SP41	2/-
1A7GT	7/9	10F1	10/-	DK96	6/3	EM34	11/6	SP61	2/-
1C5	6/3	10F18	10/-	DL68	15/-	EM71	13/6	SU25	27/2
1D6	9/6	10P13	8/3	DL96	5/9	EM80	6/3	T41	9/-
1H5GT	7/9	10P14	11/6	DL810	10/6	EM81	7/-	TDD4	8/-
1L4	2/3	11D5	17/6	DM70	5/-	EM84	6/9	TH41	13/-
1L5D	4/-	12A6	2/3	DY86	7/6	EM85	8/9	TH233	6/9
1LN5	4/6	12AC6	8/6	E80F	24/-	EM87	15/2	TP22	5/-
1N5GT	8/6	12AD6	9/6	E83F	24/-	EN31	45/-	TP25	5/-
1R5	4/-	12AE6	8/-	E88CC	10/-	EY51	5/9	TP2620	17/6
1S4	5/-	12AH8	9/-	E180F	19/6	EY81	7/3	TY86F	11/8
1S5	3/6	12AT6	4/6	EA50	1/6	EY83	9/3	U12/14	7/6
1T4	2/3	12AU6	5/9	EA76	6/9	EY84	9/6	U16	15/-
1U4	5/6	12AV6	6/6	EABC80	5/6	EY86	5/9	U18/20	6/6
1U5	5/3	12BA6	5/9	EAC91	3/3	EY88	8/9	U19	48/6
2D21	5/6	12BE6	4/9	EAF42	7/6	EZ40	5/3	U22	5/9
2X2	3/-	12BH7	6/9	EB34	1/-	EZ41	6/-	U24	12/6
3A4	3/9	12E1	16/9	EB41	4/9	EZ80	4/-	U25	8/6
3A5	6/9	12J7GT	7/3	EB91	2/3	EZ81	4/-	U26	7/3
3B7	5/-	12K5	10/-	EBC3	20/6	FC4	8/9	U31	6/9
3D6	3/9	12K7GT	3/6	EBC33	8/6	GZ33	17/6	U33	13/6
3Q4	5/3	12K8GT	9/-	EBC41	6/6	GZ34	10/-	U35	16/6
3Q5GT	7/-	12Q7GT	3/6	EBC81	6/-	GZ37	14/8	U37	29/-
3S4	4/6	12SA7	6/9	EBF80	5/6	HABC80	9/3	U45	15/6
3V4	5/3	12SH7	4/-	EBF83	7/3	HL41DD	8/6	U76	4/6
5R4GY	8/6	12SK7	3/-	EBF89	6/3	HL42DD	8/6	U101	19/6
5U4G	4/6	12SQ7	8/-	EBL21	8/-	HN309	25/-	U107	17/6
5V4G	7/6	14H7	9/6	EC70	4/9	HVR2	8/3	U191	9/6
5Y3GT	4/3	19AQ5	7/3	EC81	27/6	HVR2A	8/9	U281	8/9
5Z3	7/-	19H1	6/-	EC92	6/6	KT33C	4/-	U282	12/3
5Z4G	7/-	20D1	10/-	ECC32	4/-	KT36	29/1	U301	11/3
6A8	5/9	20D2	21/-	ECC34	21/7	KT41	7/6	U329	9/-
6AG5	2/6	20F2	11/6	ECC35	5/9	KR44	5/-	U339	9/6
6AG7	5/9	20L1	12/6	ECC40	7/-	KT61	6/9	U403	9/9
6AK5	4/9	20P1	12/6	ECC81	3/6	KT66	12/3	U404	6/-
6AQ5	5/9	20P3	12/-	ECC82	4/6	KT88	28/-	U801	16/3
6AT6	3/9	20P4	13/6	ECC83	4/6	KTW61	4/9	U4020	6/6
6AU6	5/3	20P5	12/3	ECC84	5/9	KTW62	5/6	UABC80	5/-
6AV6	5/6	25A6G	7/6	ECC85	6/3	KTW63	5/6	UAF42	7/-
6B8G	2/6	25L6GT	8/-	ECC88	10/-	MHLD6	12/6	UB41	10/6
6BA6	4/6	25Z4G	6/6	ECC189	11/6	MU14	4/6	UBC41	6/3
6BG6G	13/6	25Z5	7/3	ECC807	22/6	N37	28/3	UBC81	6/3
6BE6	4/9	27SU	23/3	ECF80	6/-	N78	26/-	UBF80	5/9
6BH6	5/3	28D7	6/9	ECF82	6/3	N108	26/2	UBF89	6/9
6BJ6	5/6	30C1	5/6	ECF86	11/6	N339	15/-	UBL21	9/9
6BQ7A	7/6	30C15	9/-	ECF80	24/-	PABC80	6/9	UC92	6/3
6BR7	8/6	30F5	5/9	ECH21	9/9	PC86	10/3	UCC84	8/9
6BR8	8/-	30FL1	9/3	ECH35	6/3	PC88	14/6	UCC85	6/3
6B87	25/-	30FL12	11/-	ECH42	7/6	PC95	11/8	UCF80	8/9
6BW6	6/9	30L1	5/6	ECH81	5/9	PC97	7/9	UCH21	8/3
6BW7	5/-	30L15	9/3	ECH83	6/6	PCC84	5/6	UCH42	7/-
6C5	4/-	30P4	12/3	ECH84	9/6	PCC85	6/9	UCH81	6/6
6CD6G	18/-	30P12	7/6	ECL80	6/-	PCC88	10/6	UCL82	7/9
6CH6	5/-	30P19	12/3	ECL82	7/-	PCC89	7/9	UCL83	8/6
6CW4	24/-	30PL1	8/6	ECL83	9/6	PCC189	10/6	UF41	6/9
6D3	9/6	30PL13	9/6	ECL86	8/3	PCF80	5/6	UF42	4/9
6E5	9/6	30PL14	12/6	EF9	20/6	PCF82	6/3	UF80	6/3
6F1	9/6	35A5	20/9	EF22	6/6	PCF84	8/6	UF85	6/9
6F6G	3/9	35L6GT	6/9	EF36	3/3	PCF86	7/9	UF86	9/-
6F7	5/-	35W4	4/9	EF37A	6/6	PCL82	6/6	UF89	6/-
6F13	4/9	35Z3	16/4	EF39	3/9	PCL83	7/9	UL41	6/6
6F23	9/-	35Z4GT	4/6	EF40	8/9	PCL84	7/-	UL44	23/3
6F24	9/6	35Z5GT	5/9	EF41	6/9	PCL85	7/6	UL46	8/6
6F33	3/6	50C5	6/6	EF42	4/9	PCL86	8/9	UL84	6/-
6J5G	3/-	50L6GT	6/3	EF50	2/6	PCL88	12/6	UM4	1"/2
6J6	3/-	72	6/6	EF54	3/-	PEN45	7/-	UM34	16/10
6J7G	4/6	78	4/9	EF73	5/-	PEN45DD		UM80	8/3
6K7G	1/3	80	5/3	EF80	3/9		12/-	UR1C	6/6
6K8G	3/3	83	15/-	EF83	9/9	PEN383	10/3	UU6	9/-
6K25	24/-	85A2	8/6	EF85	4/9	PEN4531	D	UU7	7/6
6L1	10/-	90AG	67/6	EF86	6/-		10/-	UU8	11/6
6L7GT	4/6	90AV	67/6	EF89	4/-	PENDD		UY1N	10/3
6L18	10/-	90CG	42/-	EF91	3/-	4020	17/6	UY21	8/-
6LD3	6/6	90CV	42/-	EF92	2/6	PL33	9/-	UY41	4/6
6N7GT	5/-	90C1	16/-	EF97	11/8	PL36	8/-	UY85	5/-
6P28	11/6	150B2	16/6	EF98	10/-	PL38	16/-	VMS4B	12/-
6Q7G	4/6	185BT3	4/11	EF183	7/9	PL81	6/9	VP4	14/6
6R7G	5/9	866A	12/6	EF184	7/9	PL82	5/3	VP4B	20/5
6SL7GT	5/-	5763	7/6	EK32	6/-	PL83	5/3	VP13C	7/-
6SN7GT	4/-	AZ1	5/9	EL32	5/9	PL84	5/6	VP23	2/6
6U4GT	8/6	AZ31	6/6	EL33	6/9	PL500	15/9	VP133	9/9
6U5G	5/-	AZ41	6/6	EL34	8/6	PM84	9/3	VR105	5/6
6V6G	3/9	B36	4/9	EL36	9/9	PX4	9/-	VR150	4/9
6V6GT	5/6	BL63	10/6	EL38	12/-	PX25	8/6	W76	3/6
6X4	3/9	CCH35	12/6	EL41	7/3	PY31	6/6	W81M	5/9
6X5	4/6	CL33	11/6	EL42	7/6	PY32	8/6	X41	15/-
6/30L2	8/3	CY1	16/4	EL81	8/3	PY33	8/9	X61	6/3
7B6	12/6	CY31	5/9	EL83	6/9	PY80	5/-	X65	5/6
7B7	7/-	D15	13/6	EL84	4/9	PY81	5/-	X66	7/3
7C5	7/3	D43	17/9	EL85	7/6	PY82	4/9	X76M	9/-
7C6	6/9	DAF96	5/9	EL86	7/3	PY83	5/9	X78	20/6
7H7	5/9	DD41	12/3	EL91	2/6	PY88	7/9	X79	20/6
7E7	12/6	DF66	15/-	EL95	5/6	PY800	6/6	Y63	5/-
7Y4	5/-	DF96	5/9	EL360	27/-	PY801	7/-	Z66	7/3

MIDGET SILICON RECTIFIERS

Mulla.d BY100

Output 250 v. at ½ amp.

No larger than a shirt button. 7/6 each.

TRANSISTORS AND DIODES

AC107	14/6
AC127	9/6
AD140	25/-
AF102	27/6
AF114	11/-
AF115	10/6
AF116	10/-
AF117	5/6
AF118	20/-
AF124	10/-
AF125	10/6
AF126	10/
AF127	9/6
BYZ13	11/6
MAT100	7/9
MAT101	8/6
MAT120	7/9
MAT121	8/9
OA5	4/-
OA10	5/
OA70	3/-
OA73	3/
OA79	3/-
OA81	3/-
OA85	3/
OA86	4/
OA90	3/-
OA91	3/-
OA95	3/6
OA210	9/6
OA211	13/6
OC16W	35/-
OC19	25/-
OC22	22/-
OC23	57/-
OC25	12/-
OC26	25/-
OC28	12/6
OC29	25/6
OC35	18/-
OC36	21/6
OC41	8/-
OC42	8/6
OC43	12/6
OC44	8/3
OC44PM	11/-
OC45	8/-
OC45PM	10/-
OC65	22/6
OC66	25/-
OC70	6/6
OC71	3/6
OC72	8/-
OC73	16/-
OC74	8/-
OC75	8/-
OC76	8/6
OC77	12/-
OC78	8/-
OC81	4/-
OC81D	4/-
OC81M	8/-
OC82	10/-
OC83	6/-
OC84	8/-
OC139	12/-
OC140	19/-
OC170	8/6
OC171	9/-
OC200	10/6
OC201	29/-
OC203	14/-
OCP71	17/6
ORP12	12/6
TS2	12/6
TS3	15/-
XA102	19/6
XA103	15/-

METAL RECTIFIERS. DRM1B **13/-**; DRM2B and DRM3B **15/6**; LW7 **21/6**; LW15 **24/-**; RMO **7/11**; RM1 **5/3**; RM2 **6/3**; RM3 **7/9**; RM4 **12/9**; RM5 **17/6**; 14A86 **17/6**; 14A97 **19/6**; 14A100 **23/-**; 14A124 **26/6**; 14A163 **35/6**; 14B130 **31/-**; 14B261 **11/6**; FC101 **16/9**; 16RC1.1.16.1 **8/-**; FC31 **21/-**; 16RD 2.2.8.1 **11/-**; 16RE 2.1.8.1 **8/6**; 18RA 1.1.8.1 **4/-**; 18RA 1.2.8.1. **11/-**; FC116 **6/-**; FC124 **12/6**.

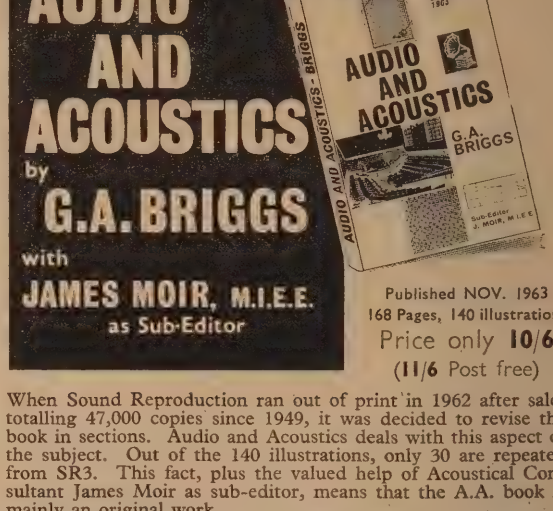
ELECTROLYTICS. Can types:—32 × 32/450 v. **5/9**; 50 × 50/350 v. **7/-**; 64 × 120/350 v. **8/3**; 60 × 250/275 v. **9/6**; 100 × 400/275 v. **12/6**; 100/275 v. **3/-**; 200/275 v. **4/-**; 100 × 200/275 v. **9/6**; Wire-ended types:—8/450 v. **1/9**; 16/450 v. **2/9**; 32/450 v. **3/9**; 8 × 8/450 v. **3/-**; 16 × 16/450 v. **4/-**; 32 × 32/350 v. **4/-**; 8 × 16/450 v. **3/9**; 32/350 v. **3/-**;

BRIDGE RECTIFIERS. 12 v./1 amp. **7/6**; 12 v./2 amp. **11/6**; 12 v./4 amp. **17/-**; 12 v./8amp. **23/-**; 6 v./2 amp. **7/6**; 6 v./4 amp. **11/6**; 6 v./8amp. **17/-**; 6 v./12 amp. **23/-**. Post 1/6 each.

All goods are new, first quality brands only, and subject to maker's full guarantee; We do not handle manufacturers' seconds nor rejects, which are often described as "new and tested" but have a limited and unreliable life.

Terms of business:—Cash with order or C.O.D. only. Post 6d. per item. Orders over £3 post free. C.O.D. 3/6 extra. All orders cleared on day of receipt, and C.O.D. orders by telephone accepted for immediate despatch until 3.30 p.m. Any parcel insured against damage in transit for only 6d. extra. Callers welcome Mon.-Fri., 8.30-5.30, Sats. 8.30-1 p.m. Complete catalogue of over 1,000 valves stocked with resistors, condensers, transformers, volume controls, switches, etc., 6d. post free.

5WW—155 FOR FURTHER DETAILS.



Published NOV. 1963
168 Pages, 140 illustrations
Price only **10/6**
(**11/6** Post free)

When Sound Reproduction ran out of print in 1962 after sales totalling 47,000 copies since 1949, it was decided to revise the book in sections. Audio and Acoustics deals with this aspect of the subject. Out of the 140 illustrations, only 30 are repeated from SR3. This fact, plus the valued help of Acoustical Consultant James Moir as sub-editor, means that the A.A. book is mainly an original work.

PRAISE INDEED for AUDIO & ACOUSTICS

"I finished your latest book last week. In my opinion it is the best you have done. There is a very great deal of meat in it, yet all of it can be digested without specialised training. This is rare indeed."

Extract of letter from P. J. Walker, Huntingdon.

WHARFEDALE WIRELESS WORKS LTD.

IDLE BRADFORD YORKSHIRE

Telephone: Idle 1235/6 *Grams 'Wharfdel' Bradford*

5WW—156 FOR FURTHER DETAILS.

THE HIGH-FIDELITY MAIL ORDER SPECIALISTS

GOODS DESPATCHED BY RETURN

Carriage, Packing & Insurance (U.K.) FREE!!

AMPLIFIERS . TUNERS . SPEAKERS . MOTORS . PICKUPS . MICROPHONES . CABINETS . TAPE RECORDERS

QUAD, LEAK, ROGERS, DULCI, ARMSTRONG, CHAPMAN, JASON, WHARFEDALE, T.S.L., GOODMANS, GARRARD, G.E.C., CONNOISSEUR, W.B. COLLARO, LENCO, ACOS, B. J. PHILIPS, LUSTRAPHONE, RECORD HOUSING, FERROGRAPH, VORTEXION, BRENELL, WEARITE, TANNOY, LOWTHER RONETTE, FI-CORD, S.M.R., ETC.

Hire Purchase terms available • "Comparator" Demonstrations

WORLD WIDE EXPORTERS

★ *OVERSEAS ORDERS SENT FREE OF PURCHASE TAX AND SHIPPED PROMPTLY AT MINIMUM COST* ★

C. C. GOODWIN (SALES) LTD.

(Dept. W51) 7 THE BROADWAY, WOODGREEN

LONDON, N.22. *Open 9-6 Thurs. 1 p.m.* **Tel: BOWes Park 0077/8**

5WW—157 FOR FURTHER DETAILS.

TRANSFORMERS

COILS *LARGE OR SMALL QUANTITIES*

CHOKES *TRADE ENQUIRIES WELCOMED*

SPECIALISTS IN

FINE WIRE WINDINGS

MINIATURE TRANSFORMERS
RELAY AND INSTRUMENT COILS, ETC.
VACUUM IMPREGNATION TO APPROVED STANDARDS

ELECTRO-WINDS LTD.

CONTRACTORS TO G.P.O., A.W.R.E., L.E.B., B.B.C., ETC.

123-5-7 PARCHMORE ROAD, THORNTON HEATH, SURREY
LIVINGSTONE 2261 EST. 1933

5WW—158 FOR FURTHER DETAILS.

Samson's (ELECTRONICS LTD)

LONDON'S LARGEST SUPPLIERS OF ELECTRONIC EQUIPMENT
9 & 10 CHAPEL STREET,
LONDON, N.W.1.
Tel. PAD 7851 AMB 5125

HEAVY DUTY L.T. TRANSFORMERS

All primaries 220-240 volts. Terminal block connections.

No.	Sec.Taps	Price			Carr.
1	25, 30, 35 v., 40 a....	£11	19	6	10/–
2	25, 30, 35 v., 20 a....	£6	19	6	7/6
3	25, 30, 35, v., 10 a....	£4	15	0	5/–
4	25, 30, 35 v., 2 a.....	£1	17	6	3/6
5	10, 17, 18 v., 10 a....	£2	17	6	4/–
6	24 volts, 30 amps....	£7	15	0	7/6
7	20 volts, 30 amps....	£6	15	0	7/6
8	50 volts, 15 amps....	£6	19	6	7/6
9	30 v., 40 v., 50 v., 5 a.	£4	15	0	5/–
10	24, 36, 48 v., 8 a.....	£4	19	6	5/–
11	17, 18, 20 v., 20 a....	£4	19	6	5/–
12	6, 12 v., 20 a.....	£3	12	6	5/6
13	20 volts, 20 amps....	£4	15	0	7/6
14	30, 32, 34, 36 v., 5 a.	£2	17	6	4/–
15	6, 12 v., 10 a.....	£2	2	6	4/–
16	12 volts, 5 amps.....	£1	9	6	3/–
17	24 volts, 10 amps....	£3	5	0	4/–
18	24 volts, 5 amps.....	£1	19	6	3/6
19	48, 56, 60 v., 1 a.....	£1	9	6	3/6
20	12, 24, 30, 48 v., 2 a.	£2	5	0	3/6
21	6.3 volts, 15 amps....	£1	17	6	3/6
22	6.3 v., 5 a., and 6.3 v., 1 a.		15	0	3/6
23	12, 24 v., 1 a.....		15	0	2/6
24	9, 15 v., 2 a.....		17	6	2/6
25	6, 9, 15 v., 4 a.....	£1	5	0	3/6
26	12, 18 v., 10 a.....	£2	12	7	4/–
27	12, 18 v., 20 a.....	£3	19	6	5/–
28	10, 18, 20 v., 9 a.....	£3	9	6	5/–
29	15 v. ct., 5 a.....	£1	5	0	3/6
30	10-11-12 v., 1½ a....		10	6	2/–

Multi-Tapped TRANSFORMERS
Pri. 2,500, 230, 250 volts. Sec. T. 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24, 30 volts. 5 amps., **45/-**. P.P. 4/-. 4 amps., **39/6**. P.P. 3/-. 2 amp., **25/-**. P.P. 3/-.

A.M. HEAVY DUTY AUTO. STEP-UP OR STEP-DOWN TRANSFORMERS
Designed for the Air Ministry for mains boosting or operating 110 v. equipment. **10 kVA.** Tapped 200, 240, 230, 220, 120, 115, 110 105 volts. Completely enclosed in metal case. Size 27 x 17 x 14in. Weight approx. 3 cwt. **£29/10/-**. **5 kVA.** Tapped as above. Size 23 x 14 x 11in. Weight approx. 2 cwt., **£19/10/-**. All transformers supplied new and guaranteed and offered at a fraction of maker's price. Carr. extra.

TRANSFORMER UNIT TYPE AP61774
Comprising Parmeko hermetically sealed transformer, pri. 230 v., Sec. 24 volts, very conservatively rated at 2 amps. Built into a metal case* with fitted neon indicators, and fuses. Shielded input and output terminals. Supplied brand new in maker's cartons at a fraction of original cost, **29/6**. Carr. 5/-.
*Size 7½ x 4 x 4in.

JUST ARRIVED!! HEAVY DUTY L.T. TRANSFORMERS BUILT TO MINISTRY SPEC.
Pri. tapped 105, 115, 125, 210, 230, 250 v. Sec. 27 volts., 60 amps. Hermetically sealed in metal case. Size 11¼ x 10 x 8in. Top mounted terminals. Manufactured by famous makers and supplied brand new in original wooden packing cases. **£12/10/-**. Carr. 10/-

A.M. ISOLATION TRANSFORMERS. Pri. tapped 100-200-220-240 v. Sec. 225 volts. Very conservatively rated at 1.1 amps., double wound. **£3/15/-**. Carr. 7/6.

FOSTER DOUBLE WOUND STEP-DOWN TRANSFORMERS
Pri. 220-240 v. Sec. 110 v. 2 kVA. Shrouded. Guaranteed in perfect condition. **£9/15/-**. Carr. 10/-.

SPECIAL OFFER OF H.T. TRANSFORMERS
SUPPLIED BRAND NEW AT A FRACTION OF MAKER'S PRICE
GRESHAM "C" CORE. Pri. tapped 200-250 v. Sec. 625-0-625 v. 250 m/a. (D.C.), 3 kV. R.M.S. test. 6.3 v. ct., 4 a., 6.3 v. 3 a., 6.3 v. 3 a. **69/6** plus 7/6 carr. **GARDNERS ENCLOSED TYPE** Pri. tapped 200-250 v. Sec. 450-400 v. 0-400 v.-450 v. 180 m/a. (D.C.). 6.3 v. 3 a., 6.3 v. 3 a., 6.3 v. 3 a., 5 v. 3 a. **47/6**, carr. 5/-.

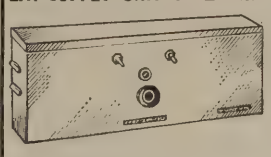
GARDNERS "C" Core. Hermetically sealed in oil filled cases. Pri. tapped 200-250 v. Sec. 4,000 v. 10 m/a., 4 v. 1.5 a., 4 kV wkg., 2-4 v. 2 a., 4 kV wkg. **£3/10/-**. Carr. 6/-.

PEARCE TRANS. CO.
Pri. tapped 200-250 v. Sec. 3,000 v. 20 m/a. **35/-**. P.P. 3/6.

REDCLIFFE "C" CORE
Pri. tapped 200-250 v. Sec. 350-300 v., 0-300 v.-350 v., 75 m/a. (D.C.), 6.3 v. 3 a., 6.3 v. 3 a. **32/6**. P.P. 4/-.

VARIABLE VOLTAGE TRANSFORMERS
0-260 v. 2½ amps., completely shrouded with control knob and dial. Brand new, **£5/17/6**. Carr. 4/-. Other sizes available.

L.T. SUPPLY UNIT TYPE S.E.1



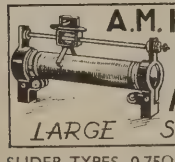
A.C. input 200-240 v. D.C. Output tapped to give 12 or 24 volts 8 amps. continuous rating. Fitted with panel fuse. Mains on/off switch and D.C. output socket. Built in strong metal case. Size 15 x 6 x 6in. An ideal general purpose L.T. supply unit for operating relays. Contactors, battery charging, etc. **£9/19/6**, carr. 7/6.

MAGNETIC DEVICES SOLENOIDS
180 v. D.C. Type 42661. Overall size 1½ x 1½ x 1½ inches. Approx. ½in. pull. **5/-**. P.P. 1/6. **48/-** per doz. P.P. 4/-.

HIGH GRADE M.C. D.C. VOLTMETERS
180-280 volts 5¼ x 2in. Rectangular dial Set in wall mounting case, size 8 x 6¼ x 3¼in. with lamp fitting to illuminate dial. Supplied brand new at a fraction of maker's price, **37/6**, P.P. 3/6.

CROMPTON PARKINSON A.C. VOLTMETERS.
90-180 v. M.I. 50 cycles. 4½in. scale. Flange mounting. Supplied new and guaranteed at a fraction of maker's price. **27/6**. P.P. 4/-.

SPECIAL OFFER—E.A.C. LTD. A.C. 0-300 VOLTMETERS.
6 inch flush mounting, iron case protected, panel hole 6⅜in. Supplied brand new in sealed cartons at a fraction of maker's price. **£3/15/-**. Carr. 4/-.



4Ω 8 Amps. SINGLE TUBE SLIDER ENCLOSED, **30/-**, P.P. 4/-. 100Ω 1 Amp. SINGLE TUBE SLIDER ENCLOSED, **25/-**. P.P. 3/-. 25Ω 4 Amps. SINGLE TUBE SLIDER, **22/6**, P.P. 3/-. SINGLE TUBE ROTARY SWEEP SLIDER TYPES, 0.75Ω 12 Amps., **17/6**. 1.2Ω 10 Amps., **17/6**. P.P. 3/-. 1Ω 12 Amps. SINGLE TUBE SLIDER, **12/6**, P.P. 2/6. 12,000Ω 0.003 Amp. DOUBLE TUBE GEAR DRIVE, **29/6**, P.P. 4/6. 520Ω 2.3/0.45 Amp. SINGLE TUBE FIXED RESISTORS, **10/6**, P.P. 3/-. 26Ω 4 Amps. 6IN. DIA. RHEOSTATS, **45/-**. Carr. 4/-.

DOUBLE WOUND STEP-DOWN TRANSFORMERS, 300 WATTS.
Pri. 220, 230, 240 v. Sec. tapped 100-110 v. Enclosed in metal case fitted with 2-pin American socket or terminal blocks. Manufactured by famous makers. **65/-**. Carr. 5/-

SPECIAL OFFER OF L.F. CHOKES
Manufactured by famous makes. Supplied brand new and guaranteed. 10 H. 250 m/a. 124Ω open construction. **15/-**. P.P. 4/-. 15 H. 250 m a. 125Ω. Sealed. Oilfilled. "C" core. **22/6**. P.P. 5/-. 10 H. 120 m/a. 250Ω sealed. O.F. "C" core. **10/6**. P.P. 3/-. 0.1 H. 1 amp. 2Ω open construction, **10/6**. P.P. 2/6. 10 H. 75 m/a. 200Ω open construction. Also available low resistance smoothing. Let us know your requirements.

AMERICAN 1 MFD. 20 kV. WKG. CAPACITORS. Tropically rated Size H. 11in. plus insulated terminals, 5in. W. 13in. D. 4in. Supplied brand new in maker's packing cases at a fraction of original price. **£6/19/6**. Carr. 7/6.

OTHER TYPES AVAILABLE
AMERICAN. All tropically rated. 10 mfd., 300 v. wkg., **5/6**. P.P. 2/-. 8 mfd., 50 v. wkg., **7/6**. P.P. 2/-. 3 mfd., 1,000 v. wkg., **7/6**. P.P. 2/-. 0.15+0.15 mfd., 8,000 v. wkg., **10/6**. P.P. 1/6. 0.1 mfd., 7,000 v. wkg., **8/6**. P.P. 1/6. 0.2 mfd., 5,000 v. wkg., **7/6**. P.P. 1/6. 8 mfd., 1,500 v. wkg., **17/6**. P.P. 2/6. 10 mfd., 600 v. wkg., **8/6**. P.P. 2/-. 2 mfd., 5 000 v. wkg., **£3**. Carr. 4/-
T.C.C. 1 mfd. 7,500 v. wkg. at 70°C., **50/-**. Carr. 7/6. 0.5 mfd., 15,000 v. wkg. at 60°C., **79/6**. Carr. 7/6. 0.001 mfd., 15,000 v. wkg. **45/-**. Carr. 5/-. 1.5 mfd., 4,000 wkg., **12/6**. P.P. 2/6. 1 mfd., 2,500 v. wkg. at 60°C., **15/-**., P.P. 2/-. 0.5 mfd., 7,500 v. wkg. at 71°C., **25/-**. P.P. 2/6. 4 mfd., 1,500 v. wkg. at 71°C., **10/6**. P P. 2/-. 4 mfd , 1,000 v. wkg. at 60°C., **7/6**. P.P. 2/-. 10 mfd., 450 v. wkg. at 140°F., **8/6**. P.P. 2/-. 8 mfd., 600 v. wkg. at 71°C. P.P. 7/6. 2 mfd., 200 v. wkg. at 71°C., **2/6**. P.P. 1/6. 1 mfd., 500 v. wkg. at 60°C., **2/-**. P.P. 1/-.
DUBILIER. 4 mfd., 3,000 v. wkg. at 71°C., **25/-**. P.P. 3/-. 2 mfd, 2,500 v. wkg. at 71°C., **17/6**. P.P. 2/6. 1 mfd., 5,000 v. wkg. at 71°C., **25/-**. P.P. 3/-. 0.5 mfd., 5,000 v. wkg. at 71°C., **15/-**. P.P. 3/-. 0.25 mfd., 7,500 v. wkg. at 71°C., **17/6**. P.P. 3/-. 0.25 mfd., 5,000 v. wkg. at 71°C., **12/6**. P.P. 2/6. 0.1 mfd., 5,000 v. wkg., **10/6**. P.P. 2/6. 8 mfd , 900 v. wkg. at 71°C., **8/6**. P.P. 2/-. 0.5 mfd., 10,000, **37/6**. Carr. 3/6.
I.B.M. D.C. SUPPLY UNITS. Designed to give 75 volts 2½ amps. D.C. output from A.C. 200-250 volts. **65/-**. Carr. 5/-.

MAINS BOOSTING TRANSFORMERS
Auto wound. Tapped 220, 230, 240, 250 v., 750 watts. Supplied brand new at a fraction of maker's price. **59/6**. Carr. 5/-.

PHILIPS SODIUM LAMP BALLAST TRANSFORMERS MB/U. 1,000 watts, 220-250 v. 50 cycles. Brand new. **£4/15/-**. Carr. 7/6.

VENNER ELECTRIC TIME SWITCHES. 200-250 v. A.C. 15 amp. contacts, once on, once off every 24 hours. Any manually preset times. Manual on/off shorting switch, complete with mounting block. Perfect condition. **69/6**. P.P. 3/6.

ROLLER TYPE MICRO SWITCHES

Normally closed. **54/-** doz. Normally open. **54/-** doz. Universal, **60/-** doz.

A.C. 200-240 v. CHECK METERS. 25 amps. L.R., **32/6**. P.P. 3/-. 10 amp. L.R., **22/6**. P.P. 3/-. 5 amp. L.R., **17/6**. P.P. 2/6. Guaranteed in perfect condition.

SPECIAL OFFER BRAND NEW A.M. LEAD ACID ACCUMULATORS. 2 v. 14 A.H. Size 6⅜in. high, 2in. sq. Ideal for constructing 6 or 12 v. batteries. **4/11** each. P.P. 2/-. Six for **27/-**. Carr. 5/-. Supplied with charging instructions.

EQUIPMENT WIRE 14/36 P.V.C. 100 yd. coils, 9 different colours. **65/-**, carr. 4/-. Ten coils, carr 5/-. Single coils, **7/6**, carr. 1/6.

5WW—159 **FOR FURTHER DETAILS.**

VALVES

Brand new, individually packed and guaranteed

AC/HL 4/6	DL93 . . 6/-	EF41 . . 6/9	G1/286G 9/-	PCL84 7/-	U12/14 8/-	1LA6 . . 6/-	6AL5 3/-	6L6 . . 9/-	12C8 3/-	80 . . . . 5/6	8013A 25/-
ACP4 6/-	DL94 6/-	EF52 . . 6/-	G1/371K18/-	PCL86 9/-	U17 . . 5/-	1LC6 . . 7/-	6AL5W 7/-	6L6G 6/-	12H6 2/-	81 . . . . 9/-	9001 . . 3/-
AC6PEN 5/-	DL96 6/-	EF54 . . 3/3	G50/2G 5/-	PEN25 4/6	U18 . . 6/6	1LH4 . . 4/-	6AM5 2/6	6L6GA 7/6	12J5GT 2/6	82 . . . . 3/-	9002 . . 4/6
AR8 . . 5/-	DL819 15/-	EF71 . . 7/6	GZ32 10/-	PEN46 6/-	U25 . .11/-	1N43 . . 4/-	6AM6 4/-	6L7G 4/6	12J7GT 4/6	84 . . . . 3/-	9003 . . 6/-
ARP3 3/-	E80F 25/-	EF72 . . 5/-	GZ34 . .10/-	PEN220A	U26 . .11/-	1N70 . . 4/-	6AQ5 7/-	6L34 4/6	12K8M 10/-	85A2 . . 3/6	9004 . . 2/6
ARP 3/6	E1148 2/6	EF73 . . 5/-	H63 . . 7/-		U27 . . 8/-	1R4 . . 5/-	6AQ5W 9/-	6L20 5/9	12Q7GT 4/6	80 . . . . 6/-	9006 . . 2/6
ARP12 2/6	E1232 9/-	EF74 . . 4/-	HF300 100/-	PL36 . . 8/-	U32 . . 5/-	1R5 . . 4/-	6AS6 . . 4/-	6N7 . . 6/-	12SA7 7/-	90C1 . . 8/-	
ARP21 7/-	E1266 50/-	EF80 . . 5/-	HK54 22/6	PL38 . .16/-	U301 10/-	1S4 . . 5/-	6AS6W 9/-	6N7G 5/9	12SC7 4/-	210VPT	
ARP24 3/6	E1415 30/-	EF85 . . 6/-	HL2K 2/6	PL81 . . 7/-	UABC80 5/-	1S5 . . 4/6	6AT6 . . 4/-	6Q7G 6/-	12SG7 3/-	7 pin 2/6	C.R. Tubes
ARP34 4/-	E1524 12/6	EF86 . . 6/-	HL23 6/-	PL82 . . 5/6	UBC41 6/6	1T4 . . 3/-	6AU6 7/-	6R7 . . 6/-	12SH7 3/-	220PA 7/-	CV1596
ARTP1 6/-	B2134 16/-	EF89 . . 4/6	HL23DD	PL83 . . 6/-	UBF80 6/6	2A3 . . 5/-	6AX4 8/-	6R7G 7/-	12SJ7 5/-	220TH 4/-	(O9J) 55/-
ATP4 . . 2/3	EA50 1/6	EF91 . . 2/9	5/-	PL84 . . 6/6	UBF89 7/-	2A5 . . 6/-	6B4G 8/-	6R7GT 5/-	12SK7GT	225DD 9/-	E4103/B/4
ATP7 5/6	EA75 7/-	EF92 . . 2/-	HL41 4/-	PM24A 5/-	UBL21 11/-	2A6 . . 7/-	6B7 . . 6/-	6S87 . . 5/-	3/-	307A . . 5/8	28/-
AU7 50/-	EABC80 6/-	EF95 . . 5/-	HVR2 9/-	PT15 . .10/-	UCC85 6/6	2C26 . . 3/-	6B8G 2/6	6SF5GT 5/6	12SN7GT	350B . . 8/-	E4504/B/16
B84 10/-	EAC91 3/6	EF183 8/-	K3A . .30/-	PT25M 7/6	UCH42 7/-	2C26A 3/-	6BA6 . . 4/9	6SH7 . . 3/-	5/9	357A 70/-	28/-
B884 47/6	EAF42 8/-	EF184 8/-	KT32 8/-	PX4 . .14/-	UCH81 7/-	2C34 . . 2/6	6BE6 5/-	6SJ7 . . 5/-	12SR7 5/-	368A 5/-	VCR97 28/-
BT19 25/-	EB34 1/6	EL32 . . 3/9	KT33C 6/-	PX25 9/-	UCL82 8/-	2C43 42/6	6BR7 9/-	6SJ7GT 5/6	12Y4 2/-	393A 15/-	VCR138
BT35 25/-	EB91 3/-	EL34 . .10/-	KT44 5/9	PY32 9/6	UCL83 10/-	2C46 30/-	6BW6 9/-	6SJ7Y 6/6	14L7 7/-	446A 8/-	30/-
BT83 35/-	EBC33 6/-	EL35 . . 5/-	KT63 4/-	PY33 10/-	UF41 . . 7/6	2C51 12/-	6C4 . . 2/6	6SK7 4/6	15D2 6/-	703A 30/-	VCR138A
CC5L 2/-	EBC41 5/9	EL38 . .17/6	KT66 12/9	PY80 5/6	UF42 . . 7/-	2D21 . . 5/-	6C5G 4/-	6SL7GT 5/6	19G3 10/-	705A 15/-	40 -
C1C . . 8/-	EBC90 5/-	EL41 . . 7/3	KT67 15/-	PY81 5/6	UL41 . . 7/6	2X2 . . 3/-	6C5GT 6/-	6SN7 . . 3/6	19G6 9/-	715B 60/-	VCR139A
CL33 . . 9/-	EBF80 6/6	EL42 . . 8/-	KT76 8/6	PY82 5/-	UL84 . . 6/-	3A4 . . 4/-	6C6 . . 4/-	6SQ7 . . 6/-	19M1 8/-	801 . . 6/-	35/-
CV71 . . 3/-	EBF83 7/6	EL50 . . 9/-	KTW61 5/6	PY83 6/-	UU9 . . 8/6	3A/167/M	6C6G . . 3/-	6S87 . . 2/-	20A2 17/6	803 . .22/6	3BP1 30/-
CV77 6/-	EBF89 6/9	EL81 . . 8/6	KTZ41 6/-	PY800 6/6	UY21 . . 8/-	25/-	6C8G . . 3/-	6U4GT 9/6	20P4 15/-	805 . .30/-	3FP7 45/-
CV102 1/-	EC53 12/6	EL83 . . 7/-	KTZ63 6/-	PZ1-35 9/-	UY41 . . 5/6	3B7 . . 5/-	6CH6 5/-	6V6G 5/-	21B6 9/-	807BE 6/-	5CP1 25/-
CV103 4/-	EC70 . . 5/-	EL84 . . 5/-	LP2 10/-	PZ1-75 12/-	UY85 . . 5/-	3B24 . . 5/-	6D6 . . 3/-	6V6GT 5/6	25L6GT 8/-	808 . . 8/-	5FP7A 25/-
CV4014 7/-	EC90 20/-	EL85 . . 8/-	M8100 9/-	QP21 . . 6/-	V1507 5/6	3B28 15/-	6E5 . . 6/-	6V6M 8/-	25V5 6/-	813 . .55/-	
CV4015 5/-	EC91 . . 3/-	EL91 . . 4/6	M8142 13/-	QP25 . . 5/-	V1924 18/-	3E29 50/-	6F5G . . 5/3	6X4 . . 4/-	25Z4G 6/6	829A . .30/-	Photo Tubes
CV4025 10/-	ECC81 4/-	EL95 . . 6/-	M8190 5/-	Q895/10 5/6	V2023 13/6	3Q5GT 7/6	6F5GT 5/9	6X5G 5/-	25Z5 7/6	829B 50/-	
CV4046 40/-	ECC82 5/-	EM80 6/6	MH4 . . 5/-	Q81202 8/-	VMP4G 12/-	3S4 . . 5/-	6F6G 4/-	6X5GT 5/3	25Z6GT 8/6	830B . . 4/-	CMG8 5/-
CY31 . . 6/-	ECC83 6/-	EM81 7/6	ML6 . . 6/-	QV04/7 8/-	VP23 3/-	3V4 . . 5/9	6F7 . . 6/-	6Y6G 6/-	30 . . . . 5/-	832 . . .15/-	G816 12/6
D1 . . 1/6	ECC84 6/6	EM84 8/-	NGT2 10/-	R3 . . . . 8/-	VP133 10/-	5A173G 5/-	6F8G 6/6	N-30L2 10/-	30C15 9/6	837 . . 9/-	931A 55/-
D41 . . 3/3	ECC85 6/6	EM85 9/-	OB3 . . 7/-	SP2 . . 3/6	VR99 8/-	5A174G 5/-	6F12 4/6	6Z4 . . 5/-	30F3 . . 8/6	843 . . 5/-	6097C 350/-
D77 . . 3/3	ECC91 4/-	EN31 10/-	OC3 . . 5/6	SP41 . . 2/-	V105/30 5/6	5B/257/M	6F13 5/-	7B7 . . 7/6	30FL1 10/6	866A . .14/-	
DA30 12/6	ECF80 7/6	ES1208 6/-	OD3 . . 5/-	SP61 . . 2/-	VR150/30	19/-	6F32 4/-	7C5 . . 10/-	30P19 14/-	954 . . 4/6	
DAF96 6/-	ECF82 7/-	EY51 7/-	OZ4 . . 4/-	SP210 3/6	5-	5R4GY 9/-	6F33 . . 3/6	7C6 . . 7/-	30PL1 10/6	955 . . 2/6	Special Valves
DD41 4/-	ECH42 8/-	EY86 5/6	PABC80 7/-	STV280/40	VT4C 20/-	5T4 . . 7/-	6G6G 2/6	7C7 . . 6/-	30PL13 12/3	956 . . 2/-	
DET5 8/-	ECH81 6/-	EY91 3/-	PCC84 5/- 12/6	Z800U 20/-	VU39 6/-	5V4G 8/-	6H1 . . 6/-	7H7 . . 7/3	351.6GT 7/-	957 . . 5/-	ACT6 -8
DET20 2/-	ECH83 7/6	EZ40 . . 5/6	PCC85 7/-	Z801U 10/-	VX3256 4/-	5X4G 8/6	6H6M 1/6	7Q7 . . 7/-	35T . . 17/6	958A . . 4/-	ESU77 £10
DF73 5/-	ECL80 5/6	EZ41 . . 6/6	PCC89 10/-	1A3 . . 3/-	W21 . . 5/-	5Y3G 4/-	6J4 . . 9/-	7V7 . . 5/-	35W4 5/-	1612 . . 5/-	1B24 25/-
DF91 3/-	ECL82 7/6	EZ80 . . 5/6	PCF80 5/-	1A5GT 5/-	X66 . . 7/6	5Y3GT 5/-	6J4WA 10/-	7Z4 . . 4/6	35Z3 . . 8/-	1616 . . 3/-	30/92/E
DF92 3/-	ECL83 10/-	EZ81 . . 4/6	PCF82 6/6	1C5GT 7/-	Y63 . . 5/-	5Y3WGTB 6/-	6J5 . . 3/6	8D2 . . 2/6	35Z4GT 6/-	1619 . . 5/-	£37/10
DF96 6/-	ECL86 10/-	F/6057 5/-	PCF84 5/-	1D8GT 6/-	Y65 . . 4/-	9/-	6J5G . . 3/-	9D2 . . 3/-	35Z5GT 6-	1625 . . 6/-	723A/B 50/-
DK92 6/6	EF36 . . 3/6	F/6061 5/-	PCL81 9/-	1E7G . . 7/6	Y66 . . 8/-	5Z4G . . 7/-	6J6 . . 3/6	11E3 17/6	37 . . . . 4/-	1626 . . 3/-	725A 30/-
DK96 5/6	EF39 . 4/-	F/6063 4/-	PCL82 6/6	1F2 . . 3/-	Z800U 20/-	6AB7 . . 4/-	6J6W 6/-	12A6 . . 2/6	38 . . . . 4/-	1629 . . 4/6	726A 27/6
DL92 5/-	EF40 . . 9/-	FW4/500 6/6	PCL83 8/3	1G6GT 6/-	Z801U 10/-	6AC7 . . 3/-	6J7G 5/-	12AH7 5/-	41MP . . 4/-	2051 . . 5/-	
				1L4 . . 2/6	1A3 . . 3/-	6AG5 2/6	6K6GT 5/6	12AH8 11/-	50L6GT 8/-	4043C 13/6	
					1A5GT 5/-	6AG7 6/-	6K7G 2/-	12AT7 4/-	53A . . 7/6	4063 . . 8/-	Transistors
					1C5GT 7/-	6AH6 10/-	6K7GT 4/9	12AU7 5/-	58 . . . . 6/-	5704 . . 9/-	OC26 25/-
					1D8GT 6/-	6AJ5 . . 8/6	6K8G 4/-	12AX7 6/-	59 . . . . 6/-	5726 . . 6/-	OC44 6/-
					1E7G . . 7/6	6AJ7 . . 3/-	6K8GT 8/3	12AY7 10/-	75 . . . . 5/6	6064 . . 7/-	OC45 6/-
					1F2 . . 3/-	6AK5 5/-	6K8M 8/6	12BA6 6/-	76 . . . . 5/-	6065 . . 6/-	OC72 7/-
					1G6GT 6/-	6AK6 6/-	6K25 12/-	12BE6 7/-	77 . . . . 6/6	7193 . . 1/9	OC81 7/-
					1L4 . . 2/6	6AK7 6/-	6L5G 6/-	12H7 7/-	78 . . . . 5/-	7475 . . 3/-	OC82 10/-

MANY OTHERS IN STOCK include Cathode Ray Tubes and Special Valves.

All U.K. orders below £1 P. & P. 1/-; over £1 2/-; orders over £3 P. & P. free. C.O.D. 3/6 extra. Overseas Postage Extra at Cost.

MARCONI COMMUNICATION RECEIVERS

C.R.150. Frequency coverage 2–60 Mc/s. in 5 bands. Two I.F.s, 1st 1,600 kc/s. 2nd 465 kc/s. Image signal protecting over 40 dB up to 30 Mc/s. and 20–40 dB from 30–60 Mc/s. Self-checking calibration (built-in calibrator). Stabilisation of supply and temperature compensation. Electrical and mechanical band-spread. Metering and visual tuning indicator. Bandpass from 100 c/s to 10 kc/s. in 5 stages. Acoustic filter associated with 100 c/s. Band-pass position for CW reception. Facilities for diversity reception. In as new guaranteed condition with original mains power supply unit **£70** or without power supply unit **£60.** Carriage 30/-

C.R.150/2. Frequency coverage 1.5–22 Mc/s. in 4 bands, all other features as in C.R. 150. Price **£35.** Carriage 30/-.

P.C. RADIOS mains power supply unit for above **90/-.**

CR.150/3. Same as CR.150 with additional separate antenna trimmer on front panel, crystal controlled 1st oscillator for fixed frequency reception, muting switch (during transmission), wide band-pass extended to 13 kc/s. In as new guaranteed condition with original mains power supply unit **£75.** Carr. 30/-.

"CONNECT AND FORGET, CANNOT OVERCHARGE" "ESSTRON" MARK I AUTOMATIC BATTERY CHARGER. Initial charging rate 6–7 amps. The charging rate automatically adjusts itself to the charge in the battery. Automatic current and voltage control. Patented application of magnetic amplification to battery charging. Indicator lights show battery fully charged, receiving charge, incorrectly connected or faulty cells. Mains voltage 200/250 v. Built for 6 or 12 v batteries. Measurements 7 x 5 x 5½in. Weight 8½lb. Price **£7/19/6.** P.P 3/6.

RECEIVER TYPE R.206. MARK II. Frequency 0.55 Mc/s. to 30 Mc/s. in 6 bands. 100-250 v. A.C. or 12 v. D.C. Loudspeaker in power supply unit. High performance super heterodyne, eleven valves including a separate local oscillator valve, beat oscillator valve and two valves (amplifier and detector) in the A.V.C. system. In very good condition **£20** without power pack. Carriage and packing **15/-.**

NEW CHR. HIGH-RESISTANCE HEADPHONES. 14/-. P. & P. 1/6.

TELEPHONE HANDSET. Standard G.P.O type, new, **12/-.** P. & P. 2/-.

CRYSTALS FOR AMATEURS. 7,060 kc/s., 7,120 kc/s., 3 mm. gin spaces. **15/-.** P. & P. 2/-.

Large Selection of Main and Heavy Duty L.F. TRANSFORMERS.

R.209 RECEPTION SET. A 10-valve high-grade Super Heterodyne Receiver with facilities for Receiving R/T (A.M. or F.M.) and G.W. frequency 1 Mc/s.-20 Mc/s. Hermetically sealed Built-in miniature valves and incorporating its own vibrator power supply unit driven by a 6 v. battery (2 point connector included). The set provides for reception from rod, open wire or dipole aerial with built-in loudspeaker or phone output. Overall measurements: Length 12in., width 8in., depth 9in. Weight 23lb. in as new, tested and guaranteed condition. **£23/10/-** including special headphones and supply leads. Carriage £1.

H.R.O. SENIOR TABLE MODEL. In excellent, fully checked and tested condition (without coils and power pack), **£15/10/-.** Individual frequency coils for above **£1** each or set of 9, **£8.** Either model carriage £1/10/-.

ORIGINAL MAINS POWER PACK FOR H.R.O. 110/220 v. A.C. Brand new in original packing, **45/-.** P. & P. 4/-.

TRANSMITTER RECEIVER TYPE 68T. 3-5 Mc/s., netting facilities, low power consumption, requires 150 v. H.T. and 3 v. and 9 v. L.T. dry batteries. In good condition. **35/-.** Carriage 8/-.

VARIOMETER FOR No. 19 SET. 17/6 each. P. & P. 3/-.

CARBON INSET MICROPHONE, G.P.O. types, **2/6.** P. & P. 1/6.

SWITCHES ROTARY "OAK" TYPE. Large selection.

RELAYS HIGH SPEED 250 ohm + 250 ohm 15 mA series, 28 mA single, **17/6.**

RELAYS. Large selection of new relays type 600 and 3,000.

P. C. RADIO LTD.
170, GOLDHAWK RD., W.12
SHEpherd's Bush 4946

Open 9-5.30 p.m. except Thursday 9-1 p.m. **PERSONAL CALLERS WELCOME**

CONNECTORS FOR TGS RECEIVER TRANSMITTER AND REMOTE CONTROL with original plugs on both ends. New, **£1/17/6** each. P. & P. 2/6.

PANEL METERS (round)

0–20 microamps	2½in.	D.C.	79/-
0–50 microamps	3½in.	D.C.	45/-
0–50 microamps	2½in.	D.C.**	40/-
0–100 microamps	2½in.	D.C.**	35/-
0–100 microamps	2½in.	D.C.**	35/-
0–200 microamps	2½in.	D.C.	32/-
0–500 microamps	2in.	D.C.	21/-
0–500 microamps	2½in.	D.C.	30/-
0–1mA*	2in.	D.C.	19/6
0–1mA	3½in.	D.D.	35/-
0–1mA	3½in.	D.C.**	35/-
0–5mA	3½in.	D.C.	45/-
0–300mA	2½in.	D.C.	10/-
150–0–1,500mA	3½in.	D.C.	29/-
0–15v	2½in.	A.C.	17/6
0–50v	2½in.	D.C.	28/-
0–150v	2½in.	A.C.	24/-
0–500v (shunt)	2½in.	D.C.	20/-
0–5kV	3½in.	electrostatic	85/-
0–10kV	2½in.	D.C.	63/-
Freq. 0–70 c/sec. 195v	3½in.		52/-

*Weston, as usually used also in H.R.O. as "S" meter.
**Projection type.

PRECISION WATT METERS made by Weston (USA) for D.C. and A.C. 25-1,000 c/s. Voltage coils 150 and 300 v., current max. 7.5 amps. Mirror dial calibrated up to 1,500 watts. Connecting instructions included. Overall measurements 6¼ x 5¼ x 3¼in. Brand new **£9/19/6.**

5WW—160 FOR FURTHER DETAILS.

KEENER PRICES
★ VALVES ★
by return of post

THE MOST ATTRACTIVE COMPETITIVE VALVE LIST IN THE COUNTRY

All valves are new and unused unless otherwise advised

POST 1 Valve 6d., 2-11 1/-, FREE for 12 or more valves.

3 MONTHS GUARANTEE In writing with every valve.

FREE TRANSIT INSURANCE. Satisfaction or Money back Guarantee on Goods if returned within 14 days.

OZ4	4/9	6K7	7/3	20D1	8/9	DL32	6/-	EY86	5/6	T41	6/6
1A7GT	8/-	6K7G	1/9	20F2	9/6	DL92	8/9	EY88	9/-	TDD4	8/-
1C5GT	7/-	6K7GT	4/3	20L1	15/-	DL94	4/9	EZ40	5/6	U14	7/6
1D5	6/9	6K8G	4/9	20P1	9/6	DL84	5/6	EZ41	6/6	U18	7/6
ID6	9/6	6K8GT	8/3	20P3	12/-	DL96	6/-	EZ80	5/6	U22	5/9
1H5GT	8/-	6K25	9/6	20P4	15/-	EA50	1/3	EZ81	4/6	U24	12/6
1L4	3/3	6L1	8/9	20P5	12/6	EABC80	6/-	FC4	9/6	U25	11/-
1LD5	4/-	6L6	7/6	25A6G	7/9	EAC91	3/9	FW4/500	7/9	U26	11/-
1LN5	4/6	6L6G	6/6	25L6GT	8/-	EAF42	6/8	GT1C	9/9	U31	6/9
1N5GT	8/-	6L18	7/3	25Y5G	7/9	EB34	1/3	GZ32	10/-	U33	14/-
1R5	4/9	6L19	13/6	25Z4G	6/9	EB41	4/6	GZ34	10/-	U35	12/6
1S4	7/6	6LD20	5/9	25Z5	7/9	EB91	2/3	HABC80	9/6	U37	23/3
1S5	3/9	6N7	5/-	25Z6G	8/-	EBC33	5/9	HL41DD	8/6	U50	4/9
1T4	2/9	6P1	12/6	27SU	17/6	EBC41	6/9	HVR2	8/6	U52	4/9
1U5	6/-	6P25	7/-	30C1	5/9	EBC81	6/-	KT32	6/-	U76	5/6
2D21	5/3	6P28	9/9	30C15	9/6	EBF80	6/6	KT33C	4/-	U78	4/6
3A4	4/-	6Q7G	5/6	30F5	10/6	EBF83	7/6	KT36	14/-	U107	12/6
3A5	7/-	6Q7GT	7/9	30FL1	10/6	EBF89	6/9	KT44	5/6	U191	9/6
3D6	4/-	6R7G	6/-	30L1	5/6	EBL21	11/-	KT55	17/6	U281	9/-
3Q4	6/9	6SA7	5/9	30L15	12/6	EC52	4/3	KT61	7/-	U282	14/-
3S4	4/9	6SC7	4/6	30P4	9/6	EC91	3/-	KT63	4/6	U301	12/-
3V4	5/6	6SG7	4/6	30P12	9/9	EC92	7/6	KT66	12/6	U309	5/6
5R4GY	8/9	6SH7	3/-	30P19	14/-	ECC31	7/3	KT76	7/9	U329	9/-
5T4	7/9	6SJ7	5/-	30PL1	10/6	ECC32	3/9	KT88	19/-	U339	9/6
5U4G	4/9	6SK7	4/6	30PL13	12/3	ECC33	4/9	KTW61	5/6	U403	9/3
5V4G	7/3	6SL7GT	5/9	30PL14	12/3	ECC34	9/-	KTW62	5/6	U404	5/9
5Y3G	4/9	6SN7GT	4/9	35C5	8/6	ECC35	5/9	KTW63	5/6	U801	17/6
5Y3GT	4/9	6SQ7	5/9	35L6GT	7/-	ECC40	7/6	KTZ63	5/9	UABC80	5/-
5Y4G	8/9	6S87	3/6	35W4	5/-	ECC81	3/9	L63	3/-	UAF42	8/-
5Z4	9/-	6U4GT	9/3	35Z4GT	6/-	ECC82	4/3	LN152	5/9	UB41	6/8
5Z4G	7/-	6V6G	4/3	35Z5GT	6/-	ECC83	5/6	MU14	5/6	UBC41	6/6
5Z4GT	9/6	6V6GT	6/-	41	6/6	ECC84	6/6	N37	10/6	UBC81	7/-
6/30L2	8/3	6X4	4/6	42	5/9	ECC85	6/6	N78	11/6	UBF80	6/6
6A6	3/9	6X5G	4/9	50B5	6/9	ECC88	10/6	N108	13/-	UBF89	7/-
6A7	9/-	6X5GT	6/-	50C5	6/9	ECF80	7/6	N152	8/3	UBL21	11/-
6A8G	6/9	7B6	8/9	50L6GT	8/-	ECF82	7/-	P41	3/6	UC92	7/6
6A8GT	12/6	7B7	7/3	53KU	9/6	ECH21	11/-	P61	2/6	UCC84	9/-
6AC7	3/-	7C5	7/3	61BT	17/6	ECH35	7/6	PABC80	7/-	UCC85	6/6
6AG5	2/6	7C6	7/-	62BT	13/6	ECH42	8/-	PC86	10/3	UCF80	9/6
6AG7	5/9	7H7	5/9	75	4/9	ECH81	6/-	PC97	8/6	UCH21	8/6
6AK5	4/9	7R7	14/-	78	4/9	ECH83	7/6	PCC84	5/6	UCH42	7/-
6AL5	2/3	7Y4	6/-	80	5/3	ECL80	6/-	PCC85	7/-	UCH81	7/-
6AM6	2/9	7Z4	5/-	83	9/6	ECL82	7/6	PCC88	11/-	UCL82	8/-
6AQ5	5/9	8D3	2/9	185BT	19/6	ECL83	10/-	PCC89	10/-	UCL83	10/-
6AT6	5/-	10C1	9/6	185BTA	19/6	ECL86	10/-	PCC189	10/6	UF41	7/6
6AU6	6/-	10C2	15/-	807(A)	8/-	EF92	6/6	PCF80	5/9	UF42	7/-
6AV6	5/6	10F1	7/6	807E	5/9	EF36	3/3	PCF82	6/6	UF80	6/6
6B7	8/-	10F9	10/-	813	49/-	EF37A	6/9	PCF84	10/-	UF85	7/-
6B8G	3/-	10F18	9/6	832	14/-	EF39	4/6	PCF86	8/-	UF86	12/-
6BA6	4/9	10LD11	12/6	866A	11/6	EF40	9/-	PCL82	6/6	UF89	6/-
6BE6	5/-	10P13	12/6	954	3/6	EF41	6/9	PCL83	8/3	UL41	7/6
6BG6G	13/-	10P14	8/6	955	2/3	EF42	6/-	PCL84	7/-	UL44	14/-
6BH6	7/-	10P18	6/9	956	2/-	EF50-BR1	3/-	PCL85	7/6	UL46	8/9
6BJ6	8/-	12A6	2/3	1625	5/6	EF50(A)	2/6	PCL86	9/-	UL84	6/9
6BR7	8/-	12AH8	11/-	5763	7/6	EF54	3/3	PEN25	3/6	UM80	8/6
6BR8	8/-	12AT6	6/6	9001	3/-	EF80	5/-	PEN45	7/9	UR1C	6/9
6BW6	9/-	12AT7	3/9	9002	4/3	EF85	6/-	PEN46	4/3	UU6	9/9
6BW7	5/-	12AU6	7/8	9003	5/9	EF86	6/-	PL33	9/6	UU7	8/6
6C4	2/3	12AU7	4/3	ATP4	2/-	EF89	4/6	PL36	8/-	UU8	11/6
6C5	5/6	12AV6	6/9	AZ31	8/-	EF91	2/9	PL38	16/-	UY1N	10/6
6C6	3/-	12AX7	5/6	AZ41	6/6	EF92	2/6	PL81	7/-	UY21	8/-
6C9	10/6	12BA6	6/6	B36	6/9	EF183	8/-	PL82	5/6	UY41	5/6
6CD6G	18/6	12BE6	6/6	C1C	8/-	EF184	8/-	PL83	6/-	UY85	5/-
6CH6	5/-	12BH7	7/-	CCH35	12/6	EK32	5/9	PL84	6/6	VP4B	9/-
6D2	2/3	12C8	3/9	CL33	9/-	EL32	3/6	PL820	7/9	VP23	2/3
6D3	8/6	12E1	16/-	CY31	6/9	EL33	7/-	PM84	9/3	VP41	5/3
6D6	3/-	12H6	1/9	D77	2/3	EL34	10/-	PX4	9/-	VR105	6/-
6F1	6/6	12J5GT	2/9	DA30	11/6	EL35	7/6	PX25	8/9	VR150	6/-
6F6	6/9	12J7GT	7/9	DAC32	8/-	EL38	11/6	PY31	6/-	W76	4/9
6F6G	4/6	12K7GT	4/6	DAF91	4/6	EL41	7/3	PY32	9/-	W81	5/9
6F13	4/9	12K8	9/9	DAF96	6/-	EL42	8/-	PY33	10/-	X63	5/-
6F14	9/6	12K8GT	8/9	DF33	8/-	EL81	8/9	PY80	5/6	X65	5/6
6F15	6/9	12Q7GT	4/6	DF91	2/9	EL84	5/-	PY81	5/6	X66	7/3
6F19	5/6	12SA7	6/9	DF96	6/-	EL85	7/9	PY82	5/-	Y63	5/-
6F32	4/-	12SG7	3/9	DF97	7/6	EL86	7/6	PY83	6/-	Z63	4/9
6F33	4/-	12SH7	3/6	DH63	5/6	EL91	2/3	PY88	8/6	Z66	7/6
6H6	1/6	12SJ7	5/6	DH76	4/6	EL95	6/-	PY800	6/6		
6J5	4/9	12SK7	4/6	DK32	8/-	EM34	8/6	PZ30	9/8		
6J5G	3/-	12SN7GT	6/9	DK91	4/9	EM80	6/6	R18	9/6		
6J5GT	4/3	12SQ7	8/-	DK92	6/6	EM81	7/6	R19	7/9		
6J6	3/-	12SR7	4/9	DK96	6/6	EM84	8/-	SP41	2/-		
6J7G	4/9	13D3	5/6	DL33	7/3	EM85	9/-	SP61	2/-		
6J7GT	7/6	19AQ5	7/6	DL35	7/-	EN31	9/6	SU25	16/-		
6K6GT	6/-	19BG6	14/-	DL63	6/9	EY51	7/-	SU2150	4/6		

100's TYPES NOT LISTED S.A.E. ENQS

LEAK AMPLIFIER SNIPS

Due to a fortunate purchase we are able to make the following unrepeatable offers. All Amplifiers have line matching Output Transformers (Transformers to match these Amplifiers to 15Ω Speakers can be supplied at 22/6 each.).

TL/12 WATT (slightly used) £10
TL/25 WATT (new) £15
TL/50 WATT (slightly used) £18
Pamphonic 60 watt Amplifiers, complete with pre-amp £29
(Note—These Leak Amplifiers all have the added facility of volume and tone controls so that they can be used without a pre-amp, if very high gain is not required.

TRANSISTORS & DIODES

GUARANTEED TOP QUALITY

Huge reduction. Red Spot standard L.F. type now only **1/6**

White Spot R.F. Transistors up to 2.5 Mc/s. **2/-**

Mullard Matched Output Kits (OC81D and 2-OC81s) **12/6**

R.F. Kits (OC44, OC45 (2), 3-transistors. **12/6**

AF114	8/-	OC44	5/6
AF115	7/3	OC45	5/6
AF116	7/6	OC72	5/6
AF117	7/-	OC81	5/6
AF127	9/6	OC81D	5/6
OC26	12/6	OC82	6/-
OC36	14/-	OC170	8/6
	OC171	8/6	

GERMANIUM DIODES

General Purpose miniature detector, A.V.C., etc. or 6/6 doz. **8d.**

Gold Bonded highest quality. Individually tested. 9/6 doz. **1/-**

SILICON POWER RECTIFIERS

Guaranteed performance. Top Make. Tested 250 V working.

100mA (3 for 9/6) **3/9** 250mA (3 for 19/6) **7/6**

BULK BARGAINS

12 POTS. Popular values. 5K to 2 Meg. Unused, mixed pre-set, long sp., switched, etc. **4/6**

CONDENSERS, 25 Mixed, Electrolytic. Many popular sizes. List Value £5. Our Price **10/-**

100 RESISTORS 6/6
Excellent. Sizes ½-3 watt.

100 CONDENSERS 9/6
Miniature Ceramic and Silver Mica Condensers. 3 pF to 5,000 pF. LIST VALUE OVER £5.

100 HI STABS 9/6
1% to 5% 100Ω to 5MΩ.

EKCO L.O.P.T.

Unused replacements for Perspex cased 1954/7 models complete with E.H.T. rect. unrepeatable. **39/-**

3 VALVE AMPLIFIERS

Kit of new parts, consisting chassis, mains and output transformers, valves (P61, 6G6G, 6X5G) and all components. With full instructions for making high gain amplifier with separate bass and treble controls negative feedback, etc. Truly unusual value at **CO-AX**, low loss **6d.** yd., 25 yds. **11/6**, 50 yds. **22/-**, 100 yds. **42/6.** Co-ax Plugs **1/3.** Wall outlet boxes **3/6.**

SPECIAL C.R.T. OFFER
Due to huge Bulk Special Purchase we are offering MW 31/74 Tubes at the unrepeatable price of **29/-.** MW 36/24 ditto, **39/-.** P.P. 12/6 The above are guaranteed for 6 months.

LOUDSPEAKERS 6½in. 8in. **7/6** 3Ω Top Makes, 5in. 7 × 4in. **8/6**

TELEPHONE C.O.D. ORDERS. DISPATCHED THE SAME DAY

NEW SHOP SOUTHAMPTON
OPENING IN LARGE PREMISES

WE LOOK FORWARD TO OFFERING YOU A FIRST CLASS SERVICE at:

72, EAST STREET

With widest Stocks Keenest Prices: T.Vs, Radios, Valves, Transistors, Hi-Fi Equipment, Loudspeakers, Autochangers, Cabies, Components, etc.

TAPE-DECK BASIC KITS. Consisting of latest dual-tone portable cases with gold fittings. Standard amplifier chassis with valve holders, etc., made for B.S.R. tape decks. Will make up into beautifully compact recorder **29/-**

AM/FM TUNING CONDS.

400 + 400 pF and 15 + 15 pF. Top quality. Ideal for communications receivers to give bandspread on amateur bands. Built-in slow motion. **5/6**

VALUE!
4 watt AMPLIFIERS

excellent amplifier with high gain pre-amp stage. 10F3 driving 10P14 output stage, complete with 8in. speaker. In attractive 2-tone case, Tone control, negative feedback, ready for immediate use, individually tested. Amazing volume and clarity ideal for guitars, record players, p.a. In small halls, baby alarms, etc. Easily worth £5. Our price whilst stocks last. Carr., Packing, etc., 7/6. **45/-**

ALL-WAVE RADIOGRAM CHASSIS. Complete with full length dial and output transformer. Valve line up -UCH81, UF89-UBC81, UL84 and UY85, absolutely complete. **£4.19**

MAINS TRANSFORMERS

Excellent Quality. Guaranteed Upright mounting 250-0-250V 60 mA, 6.3V 3A. Ditto semi-shrouded 9/6. Ditto upright 80 mA 12/6. **9/6**

TWEETERS

Famous German electrostatic LSH75, easily fitted without extra transformer into existing radios, loudspeakers, etc. **4/6**

VALVE HOLDERS

B7G amphenol 6d. ea. ..... **5/-** per doz.
B9A, 7d. ea. ..... **6/-** per doz.
B9A ceramic, 7d. ea. ..... **6/-** per doz.
B9A with screens, 10d. ea. .... **8/-** per doz.

ENQUIRIES WELCOMED
Quantity Prices or Quotes for items not listed, particularly rare valves.

Tubes
Carr. & Ins. 12/6.

HIGHEST QUALITY— COMPARE OUR PRICES

MOST MULLARD MAZDA, COSSOR, EMITRON, EMISCOPE, BRIMAR, FERRANTI TYPES, PROCESSED IN OUR OWN FACTORY.

	GUARANTEED 6 months.	GUARANTEED 12 months	NEW TYPES
12in.	£2. 0.0	£3. 0.0	MW 31/74 £3.15.0
14in.	£2.10.0	£3.10.0	MW 36/24 £4.15.0
15-17in.	£3. 5.0	£4. 5.0	CRM 172 MW 43/64 £6.0.0
21in.	£3.15.0	£5.15.0	

Post: 2lbs. 2/-, 4lbs. 2/6, 7lbs. 3/6, 15lbs. 4/-, etc. (C.O.D. 2/- extra). ALL ITEMS LESS 5% AND POST FREE IN DOZENS

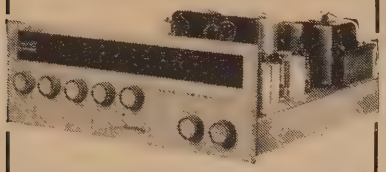
TECHNICAL TRADING CO.

RETAIL SHOP AND NEW HI-FI ROOM
350-352 FRATTON ROAD, PORTSMOUTH (Tel. 22034)
ALL MAIL ORDER RETAIL SHOP AND HI-FI ROOM (Tel.: 67999)
(Dept. 1). 11-12 NORTH ROAD, BRIGHTON.

5WW—161 FOR FURTHER DETAILS.

SPECIAL OFFERS

NO INTEREST ON 12 MONTHLY PAYMENTS



THE NEW ARMSTRONG 227 SEE PAGE 28

	Cash			Dep.	Monthly 12 pyts.	18 pyts.
ARMSTRONG						
227 Mono	£33	18	0	68/-	50/10	36/5
227 Stereo	£48	15	0	97/-	73/2	52/6
222 Amp.	£27	10	0	55/-	41/3	29/7
AF208 Chassis	£21	4	0	42/-	31/10	22/10
Stereo 55 Chassis	£29	18	0	60/-	44/10	32/2
GARRARD						
Lab.A/EV26A	£20	11	1	41/1	30/10	22/2
4HF/EV26A	£17	17	3	35/3	26/10	19/3
301 Strobe	£22	0	11	44/11	33/-	23/11
AT6/EV26A	£12	5	5	25/5	18/4	13/2
LEAK						
Stereo 20/Vari.	£55	9	0	111/-	83/2	59/8
TL12 Plus/Vari.	£34	13	0	69/-	52/-	37/4
Troughline	£29	7	6	59/6	44/-	31/7
LENCO						
GL58 Gram	£15	19	8	32/8	23/11	17/2
GL70 Gram	£26	3	2	53/2	39/2	28/1
GL88 Gram	£17	14	0	36/-	26/6	19/-
GOODMANS						
Axiette 8	£5	5	7	10/7	7/11	5/8
Axiom 10	£6	5	11	12/11	9/5	6/9
Axiom 201	£10	7	0	20/-	15/7	11/2
MISCELLANEOUS						
Cadet Stereo	£26	15	0	55/-	40/-	28/8
Decca FFSS Ster.	£18	17	11	37/11	28/4	20/4
Decca Deram A.R.I.	£11	11	0	24/-	17/3	12/5
W.B. 1012	£4	7	6	9/6	6/6	4/8
W.B. 1016	£7	0	0	14/-	10/6	7/7

Showroom hours: Monday-Saturday 10 a.m.-5 p.m. Directions: No. 6 bus from Liverpool St. Station to Orleon, Hackney Rd., walk back two turnings.

A. L. STAMFORD Ltd (DEPT. H4) Phone: SHO 5003
98 Weymouth Terrace, London, E.2.

5WW—162 FOR FURTHER DETAILS.

HOW TO BUILD TINY ELECTRONIC CIRCUITS

This work is intended to bring "miniaturized" electronics home to the amateur, experimenter and service technician and to take the mystery out of "making it smaller." In short, it is a volume on the "how to do it" of electronic miniaturization, without elaborate equipment.

By. M. Moses

30/- Postage 1/-

RADIO & LINE TRANSMISSION, by G. L. Danielson and R. S. Walker, Vol. 1, **21/-**. Vol. 2, **22/6**. Postage 1/-.
ELECTRONIC ORGAN HANDBOOK, by H. E. Anderson, **40/-**. Postage 1/-.
ELECTRONICS POCKET BOOK, by J. P. Hawker and J. A. Reddihough. **21/-**. Postage 9d.
MICROPHONES, by A. E. Robertson. **75/-**. Postage 1/-.
RADIO & TELEVISION ENGINEERS' REFERENCE BOOK, by J. P. Hawker. **£6**. Postage free.
THE OSCILLOSCOPE, by G. Zwick. **30/-**. Postage 1/-.
RADIO VALVE DATA. Compiled by "W.W." 7th Ed. **6/-**. Postage 10d.
COMPLETE CATALOGUE 1/-.

THE MODERN BOOK CO.

BRITAIN'S LARGEST STOCKIST
of British and American Technical Books

19-21 PRAED STREET
LONDON, W.2

Phone: PADdington 4185
Open 6 days, 9-6 p.m.

5WW—164 FOR FURTHER DETAILS.

RELAYS—WE HAVE 100,000 PLAIN AND SLUGGED WHICH WE CAN OFFER AT EXTREMELY COMPETITIVE PRICES TO INDUSTRIAL USERS.
Enquiries welcome for RELAYS to meet your requirements. Please state operating voltage and/or current. Contact and applied voltage.
OUR FAMOUS TRANSFORMERS. Input 200/250 v. Output tapped 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24, 30 v., 2 amp., **25/-**. 17, 11 v., 8 a., **31/-**, 5 a., **25/-**. 3.5 v. 9, 17 v., 1 a., **13/6**. P.P., Sec. 0-12-15-20-24-30 v. 4 a., **38/6**.
ACOS CRYSTAL MIC. INSERTS. 1¼in. dia., **8/-**.
HIGH GRADE MINIATURE MAGNETIC EARPHONE, complete with ear clip, lead, plug and socket, **7/6**.
F.W. METAL RECTIFIERS. 12/6 volt, 1 a., **7/6**; 3 a., **13/-**; 4 a., **17/6**; 6 a., **25/-**; 20 amp. **45/-**.
TOGGLE SWITCHES. DPDT. **3/6**. SP, **1/9**.
MICRO SWITCHES make and break, **5/6**.
MAINS TRANSFORMERS AND RECTIFIER giving 12 v. 1 a. D.C. output, **20/-**.
Ex W.D. MORSE KEYS 6/- and **8/6**.
1,000 NEW S.T.C. FREQ. CRYSTALS. 13,760 kc/s. to 19,872 kc/s., **5/6** each. Plus 6d. postage. Lists available. 10 M/C. ± 3 kc/s. with holder, **33/-**.
W/W RHEOSTATS, 12 v., 5 a., 4½ dia. in. **10/6**. 12 v. 1 a., **2/6**.
0-1 M/A METERS. M/C 2½in. F.M., **21/6**.
SET 21 H.S. TWIST DRILLS. 1/16in. to ½in. in 64ths. Packed in wooden case, **23/6**. **Set 17, 15/6.**
5in. VERNIER SLIDE CALIPERS with Depth Gauge **9/-** each. With thumb adjustment **10/6**.
6in. STEEL RULES 1/9. 12in. **2/9.** Graduated 64ths, 32nds, 16ths and ½in. × 24in. **3/6**.
PENCIL BIT SOLDERING IRONS. Latest type. Listed **22/6**. Our price **17/6**. Weight 4 ozs.
TOGGLE SWITCHES. 4-c/os. Centre off, **3/6**.
SET OF 7 B.A. Sockets 0-6 with Hex. Handle, **6/6**.
SET 6 CADMIUM PLATED WHIT. O.E. Spanners, 3/16-1/2, **11/9**.
NEW MULLARD TRANSISTORS. OC71, OC44, OC45, OC81D, OC81, **5/6** each.
12 v. MINIATURE RELAYS. 1½in. × 1½in. × 1in. Weight 1½ oz. 2 c/o., **9/6**.
6in. SIDE CUTTERS, 7/6. 5in. **6/3.** 5in. R.N. Pliers **5/9**
U.S.A NATIONAL "VELVET" VERNIER Slow Motion Dials. 4in. Dia. The finest S.M. Dial in the world. **22/6**.
Key Switches, 2 C/O., **3/-**; with lock, **4/-**.
ERICSSON UNISELECTOR SWITCHES Single Coil 75 ohm, 6 bank 25-way and 3 bank 50-way 50 v. D.C. at **37/6** each. Special prices for Quantities. **Lists sent on request. All post paid. Stamps please.**
WANTED—STROWGER RELAYS IN ANY QUANTITY

THE
RADIO & ELECTRICAL MART

P.O. Box 9 G.P.O. Tunbridge Wells, Kent.

5WW—167 FOR FURTHER DETAILS.

Radiospares Ltd.

FOR ELECTRONIC COMPONENTS—BY RETURN

TRADE ONLY

5WW—165 FOR FURTHER DETAILS.

RESISTANCE WIRES
EUREKA-CONSTANTAN
Most Gauges Available

NICKEL-CHROME MANGANIN
NICKEL-SILVER

COPPER WIRE
ENAMELLED, TINNED, LITZ, COTTON AND SILK COVERED
SMALL ORDERS PROMPTLY DESPATCHED
B.A. SCREWS, NUTS, WASHERS
soldering tags, eyelets and rivets
EBONITE and BAKELITE PANELS.
TUFNOL ROD, PAXOLIN TYPE COIL FORMERS AND TUBES, ALL DIAMETERS.
SEND STAMP FOR LIST. TRADE SUPPLIED.

POST RADIO SUPPLIES
33 Bourne Gardens, London, E.4
Phone: Clissold 4688

5WW—163 FOR FURTHER DETAILS.

DALY

Electrolytic Capacitors
* Electronic Flash
* Energy Storage
* Motor Starters

DALY (Condensers) **LTD**
Ealing Green · Ealing · London · W5
EAL 3127 · Cables: Dalycon · London

DALY

5WW—166 FOR FURTHER DETAILS.

Quartz Crystal Units

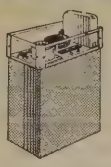
For
ACCURACY
RELIABILITY
PRICE ECONOMY
you can
DEPEND
on

Write for Illustrated Brochure & Price List.

THE QUARTZ CRYSTAL CO. LTD.
Q.C.C. Works, Wellington Crescent, New Malden, Surrey (*MALden 0334 & 2988*)

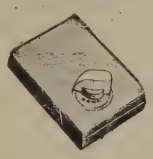
5WW—168 FOR FURTHER DETAILS

WIRELESS SET NO. 38 AFV



A lightweight walkie talkie with transmitting range 5 to 10 miles and frequency coverage 7.4 to 9 mc/s. Operates from 3 and 120 v. external dry batteries. Large, clearly numbered tuning control, with tuning lock. In good condition.
ONLY **39/6** Plus 5/- P. & P.

CRYSTAL SET



Build your own crystal set and hear it work. Easy to build and tune. Picks up main stations. **9/11** P.&P. 11d.
With personal car-piece **12/11** P. & P. 11d.
With headphones, **22/11** P.&P. 1/6

SUPERHET RADIO CHASSIS

These well-made chassis were made for the Government for Forces entertainment with 6K8, 6K7, 6Q7, 6V6. Choke smoothing slow-motion tuning, printed scale, 200-550 metres. BRAND NEW, complete with valves and 6 volt Power Pack. Cabinet with 8in. speaker to fit. Complete in maker's cartons. **£3.19.11** P. & P. 5/-.

LEAD ACID ACCUMULATORS

(Unspillable)

2 volts 16 A.H. Brand new Size 4 × 7 × 2in. **4/11** each, 3 for **12/6**
P. & P. 3/- per cell.

MOVING COIL HEADPHONES AND MICROPHONE ATTACHED

Suitable for 19 set. Not new. **6/11** P. & P. 2/3.

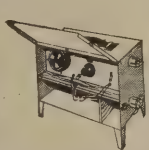
MORSE KEYS

Morse key assembly. Key with base, cover and terminals. Complete with lead. **6/11** P. & P. 2/-.

LIGHTWEIGHT HIGH IMPEDANCE HEADPHONES

Ideal for Crystal Sets and Morse Practice.
12/6 P. & P. 1/6.

TEST SET TYPE 46



Will radiate a continuous note. Range 1,250 Mc/s.—23,500 Kc/s. (12-240 Metres). 5 switched bands, contains, VR21 valve and as a precision slow motion tuning unit enclosed in grey metal case, rod aerial base on side, good condition. Power requirement, 2v., 90-120v. Battery space provided. **49/6** P. & P. 5/-.

BELLING & LEE SPARK MASTER

1. Reduces plug burning.
2. Eases starting from cold.
3. Minimises pinking.

2/6 Each. P. & P. 6d.

1155 INSTRUCTION HANDBOOK

3/11 P. & P. 3d.

XONA

NO. 19 TRANSMITTER RECEIVER

Trans/Receiver covers 2-8 Mc/s. (150-37 metres in two bands). Has an intercom, amplifier. Designed for 12 and 24 volts operation. Uses a 6-valve superhet receiver, I.F. being 465 Kc/s., and a 6-valve transmitter designed for voice and C.W. operation. Incorporates test and tuning meter for voltages, aerial loading and current tests. Panel controls frequency tuning, P.A. tuning, gain control, MCW, CW., R/T switch. Het-tone netting. Off-on quench aerial. AVC, LT-HT drives test.
ONLY **47/6** P.&P.5/-.
Instruction Handbook 3/6.

TRANSISTOR SALE

Mullard OC 44 (P. & P. 3d.)	3/11
Mullard OC 45 (P. & P. 3d.)	3/11
Mullard OC 71 (P. & P. 3d.)	2/11
Mullard OA 90 (P. & P. 3d.)	1/11
Ediswan XD202 Germanium diodes (P.&P.3d.)	1/11
Transistor Holder, 3-pin (P. & P. 3d.)	11d. Each.

MICRO ALLOY TRANSISTORS

Mat 100	7/9
Mat 101	8/6
Mat 120	7/9
Mat 121	8/6
VHF Transistor ADT 140	15/-

Above MAT's postage paid.
Ferrite Slab Aerials, suitable for transistor sets **3/-** P. & P. 6d.

TEST SET 253

Range 20-88 mc/s in 4 bands. Vernier tuning. Optional pulsed output with fine tuning 50 c/s mains operation Noise generator. Strongly made, with metal carrying case. Contains many valuable components; 9 valves, full wave rectifier unit, 3 crystals, meter, mains transformer, numerous switches, chokes, condensers, etc. **52/6** P. & P. 5/-.

VARIABLE RESISTORS

Large sturdy wirewound variable resistors. Diameter 3¼in. length (with spindle) 3½. 3.3 KΩ. Made by Marconi. **13/11** P. & P. 1/-.

Miniature wire wound variable potentiometers 6 ohm, 100 ohm, 60 ohm. each **2/11**

4 TRANSISTOR PUSH-PULL RADIO AMPLIFIER

Complete with 3 ohm output transformer, working from a standard 9 volt battery. Output in excess of 200 MW. **49/11** Post free

IDEAL FOR CHILDREN 7 YEARS AND OVER

ELECTRONIC CONSTRUCTION KITS made by GENERAL ELECTRIC CO.

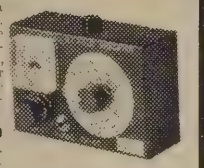
(1) Electronic Writing.
(2) Puta satellite into orbit.
(3) Build a Burglar alarm system.
(4) Weather Station.

State which one required.
42/6 EACH P. & P. 2/-.

HANDY METAL COMPONENT CASES

Hinged lid. Size 6¾in. × 6in. × 2in. Padded inside. many uses. **2/6** Each. 2 for **4/6** P. & P. 1/- each.

RF FIELD INDICATORS



Designed for checking the radiation from a transmitting antenna. The sensitivity can be controlled by adjustment of panel control, the antenna length or by increasing distance from the radiator. Frequency range 1-250 mc/s. 200mA D.C. **69/6**
Complete with instruction book.

VALVES

6B8G	1/11	P. & P. 3d.	1L4	4/-	P. & P. 3d.
6K8	3/6	P. & P. 3d.	1T4	4/-	P. & P. 3d.
6V6	3/6	P. & P. 3d.	1S4	5/6	P. & P. 3d.

DOUBLE THROAT MICROPHONE

Can be adapted for use with musical instruments.
4/11 P. & P. 1/-.

COMPONENTS

SMOOTHING CHOKES. 100 mA., 10-20H resistance, 450 ohms. Sturdy construction. P. & P. 2/6. **4/11.**

SMOOTHING CONDENSERS. T.C.C. metal enclosed block condenser, 4½, 2½, 1½in., with terminals. 8 mfd. 350 v. working. Suitable for cross-over units. P. & P. 1/6. **3/11.**

MAINS TRANSFORMER. Mains standard primary 250-0-250 v. 80 mA., 6.3 volts at 4 amps., 5 volts at 2 amps. Both tapped at 4 v. P. & P. 2/6 each, **18/11.** As above 350-0-350 v. sec. P. & P. 2/6. **19/11.**

FILAMENT TRANSFORMERS. 200-250 v. input. 50 c/s. primaries. 6.3 v. at 2 amps. P. & P. 1/3. **6/11**

PAXOLIN TAG STRIPS (14 tags). Double way. P. & P. 6d. **1/3** each.

7-WAY TAG STRIP. P. & P. 9d. Each **1/3.**

PANEL MOUNTING FUSE HOLDERS. Beautifully made, plastic sturdy construction. P. & P. 6d. Each **2/11.**

ELECTROLYTIC CONDENSERS. .05 mfd. TCC 350 v. working. P. & P. 3d. Each **1/-.**

OCTAL MOULDED VALVE HOLDERS. 6d., 3 for **1/3**; 807 valve holders, **9d.,** 3 for **2/-.** B7G valve holder ceramic moulded with screening skirt, **9d.,** 3 for **2/-.** P. & P. on each 3d.

CONDENSERS. Variable condenser solid di-electric. .0005 mFd. P. & P. 9d., **3/3.**

TRIMMERS. 0.750 pf. Max. P. & P. 3d. **9d.**

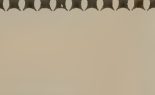
CONDENSERS. 50 mFd. electrolytic reversible, 12 v. working. P. & P. 3d. **1/3.**

1 mFd CONDENSERS. 130 v. working. Suitable as suppressors. **1/11.** P. & P. 9d. 470 pF., 10% tolerance, 750 v. working. **7d.** P. & P. 3d.

OPERATORS UNITS

A host of valuable components (block condenser jack plug, socket, etc.).
ONLY **1/11** Each P. & P. 1/6.

HOOVER ROTARY TRANSFORMERS



11.5 v. input, 490 v. output at 65 mA. from 6 v. input, approx. 250 v. output at 75mA.
PRICE **9/11**
P. & P. 3/6.

BATTERY CHARGE ADJUSTERS

- Charge Rate Adjuster.
- Government manufacture.
- Easily fitted to charging circuit.

3/6 each; 2 for 6/6. P. & P. 1/- each.

PORTABLE MAINS SOLDERING IRON

30 watts. Features removable handle that covers tip and barrel. Complete with lead and plug. ONLY **14/11** P. & P. 1/-.

PERSONAL CALLERS WELCOME AT OUR NEW BRANCH BELOW

TERMS: CASH WITH ORDER

5/- EXTRA ON C.O.D. ORDERS

XONA

TRADE SUPPLIED

SONA ELECTRONIC CO (DEPT. W.W.2)
BRIGGATE HOUSE, 13 ALBION PLACE, LEEDS 1

5WW—169 FOR FURTHER DETAILS.

Z. & I. AERO SERVICES LTD.

PLEASE NOTE **NEW ADDRESS** OF OUR HEAD OFFICE

44A Westbourne Grove, London, W.2.

Tel.: PARk 5641/2/3 **Cables: ZAERO, LONDON**

A.R.B. Approved Stockists. Approved by A.R.B. for inspection and re-issue of electronic valves and tubes.

RETAIL BRANCH (personal callers only): 85 TOTTENHAM COURT ROAD, W.2. Tel.: LANgham 8403

Please send all enquiries, correspondence, and Mail orders to Head Office

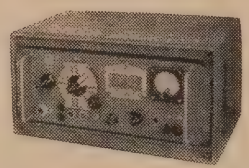
H.T. FLASH TESTERS

CT91 45 kilovolt D.C. FLASH TESTER
Voltage adjustable continuously. Microammeter leakage indicator. Trip relay for tripping the E.H.T supplies after a pre-determined leakage current is reached. Mains operation **£95 0 0**
45 kV. A.C. Flash Tester. Voltage continuously adjustable. Instrument case includes glass-door fronted test compartment for placing objects under test **£65 0 0**

HIGH FREQUENCY 'Q' METER

Frequency range 13-150 mc/s. Magnification measuring range 0-250 and 0-500. Tuning capacitance 20 to 700pF. Incremental tuning capacitor ±1pF..... **£80 0 0**

MARCONI TF934 DEVIATION TEST SET



Fundamental frequency range 2.5-100 Mc/s basic; range can be extended to 500 Mc/s by using harmonics. Deviation range 0-5, 0-25 and 0-75 kc/s. in the modulation range of 50 c/s. to 15 kc/s. Sensitivity better than 55 mV. Power supplies 100-150 and 200-250 v. A.C. Price fully overhauled and guaranteed **£85 0 0**

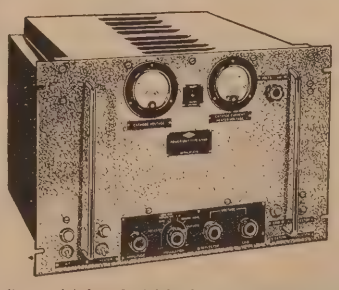
MARCONI TF144G SIGNAL GENERATORS

Frequency range 85 kc/s. to 25 Mc/s. Incremental Frequency Control. Output voltage 1 μV. to 1 V. Fully overhauled and guaranteed, supplied complete with R.F. lead with dummy aerial, mains lead and manual. **£85.** P.P. 30/-.
Extra if additional coils are supplied to extend the range down to 15 kc/s., thus extending the coverage to 15 kc/s.-25 Mc/s. **£10 0 0**

"X" BAND SPECTRUM ANALYSERS Type TSX-4SE

Self-contained mains operated (115/230 v. A.C.) instrument giving a C.R.T. Spectrum display. Covers 8,500 to 9,600 Mc/s. Built-in wavemeter. Fully overhauled and guaranteed. **£190.** P.P. £2.

KLYSTRON POWER SUPPLY UNITS Type 698



Fully regulated and stabilised rack mounted (19in.) mains operated power unit providing the following facilities:
Cathode volts—1.0 kV. to −2.4 kV.
Grid volts 0 to −200 v.
Reflector volts 0 to −500 v.
Cathode current 18 mA. max.
L.T. supplies 4.0 v. to 1.4 A.
INTERNAL GRID OR REFLECTOR MODULATION:
Square wave: 2-4 kc/s.. 70 v. peak-to-peak.
Sawtooth 150-600 c/s.; 0 to 30 v. peak.
PRICE, fully overhauled and guaranteed, **£65.**
Packing and carriage £2.

METERS

PHILIPS FIRST-CLASS MIRROR SCALE 1 mA. D.C. MC METERS

Square flange 4.6in. × 4.6in., flush mounted. Scale length 4in. Body 3.8in. dia. × 1⅞in. deep. Calibrated 0 to 1 mA. PRICE **65/-**
Other calibration supplied at an extra charge.

MINIATURE METERS

GENERAL ELECTRIC 1½in. Round flush clip mounted Moving Coil Meters:
1 mA. D.C. **30/-**
25 mA. D.C. **25/-**
75, 100, 150 mA. D.C... **20/-**

"INTERNATIONAL" SUBMINIATURE "PENNY SIZE" METERS, 1in. Round Flush ring nut mounted. 500μA FSD., Calibrated 0 to 1mA. **22/6.**

RADIO FREQUENCY METERS

Thermocouple Type

200 mA.:	2in. round, plug-in .. **12/6**	2.5 A.:	2in. round, clip mntd. **25/-**
300 mA.:	2in. round flange .. **25/-**	3 A.:	2in. sq. flge. **25/-** 2in. round, clip mntd. **25/-**
	2½in. round flange .. **25/-**		2in. sq. flge. **25/-**
350 mA.:	2in. round, plug-in .. **12/6**	3.5 A.:	2in. sq. flge. **20/-**
500 mA.:	2in. round flange .. **25/-**	4 A.:	2in. rd. flge. **20/-**
		10 A.:	2½in. rd. fl. **22/6**
		15 A.:	2½in. rd flge. **22/6**

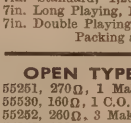
EVERSHED 250 V. "WEE" MEGGERS

Perfect condition. Complete with case **£14 10 0**

TANGENTIAL BLOWERS

230 v. A.C. motor driving a 2½in. dia. × 7in. long Centrifugal blower. Outlet size 1½in. × 7in. Suitable for cooling and ventilating interiors of electrical equipment or for blowing hot air when used in conjunction for ordinary fire elements. Two bolt mounting. Brand new. **35/-.** P.P. 7/6.

3-RANGE MICRO-MILLIAMMETER



Basic movements 50μA. D.C. M.C. Ranges of 50μA, 250μA. and 1 mA. switched by a trigger switch in the back, geared with sliding scale having separate graduations for each range. Instrument is fitted with leads for soldering to test probes or crocodile clips (not supplied) **50/-**

AVOMETERS MODEL 7

Fully overhauled and guaranteed, complete with leads **£13 5 0**
Packing and carriage 15/-.

HIGH FIDELITY RECORDING TAPES

5in. Standard, 600ft. **10/6**
5in. Long Playing, 900ft. **13/-**
5in. Double Playing, 1,200ft. **16/-**
7in. Standard, 1,200ft. **12/-**
7in. Long Playing, 1,800ft. **18/-**
7in. Double Playing, 2,400ft. **28/-**
Packing and postage 1/9 per tape.

OPEN TYPE MINIATURE RELAYS

55251, 270Ω, 1 Make **3/6**
55530, 160Ω, 1 C.O.+1 Make **5/-**
55252, 260Ω. 3 Makes **6/-**
55258, 130Ω, 6 Makes **6/6**
Dimensions approx. 1½ × 1½ × 2½in. P.P. 1/6 per relay.

TELEPHONE DIALS

"Provincial" Type Automatic Telephone Dials, with numbers only, recovered from equipment, in good condition. **12/6.** P.P. 1/9.

C.R.T. MONITOR TYPE 103

3in. C.R.T. Type VCR139A. Triggered Time Base providing speeds of 10-50-200-1,000-5,000-20,000 μsec. "X" shift calibrated in μsec. for direct measurement of time intervals. "Y" amplifier providing gain of ×5 and ×20. Metered "Y" shift for direct measurement of voltages up to ±500 V. Time base expansion control. A pulse of 30 V. positive or negative is required to trigger the time base. Power supplies required are: 600 V. EHT at 300 mA., 6.3 V. at 10 A., 4 V. at 2 A. and negative 2,200 V. at 6 mA. PRICE, checked, in perfect condition, complete with circuit diagram and description **£7 0 0**
Packing and carriage £1.

OSCILLOSCOPE POWER SUPPLY UNIT TYPE 917

Mains operated (230 V. A.C.) Power Unit providing the following outputs: 600 V. at 300 mA. dropped down to 450 V., 2,200 V. at 6 mA. Three separate 6.3 V. A.C. supplies at 2.15 A., 3.6 A. and 3.6 A., and 4.0 V. at 2 A. All H.T. supplies are fully smoothed and fused. This unit originally designed for use with C.R.T. Monitor Type 103 can also be used to supply any other oscilloscope. PRICE, perfect condition, complete with the necessary plugs and sockets **£5 0 0**
Packing and carriage £1.

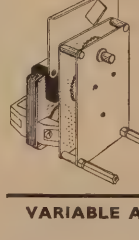
DOUGLAS TRANSFORMERS

Battery charging. Input 200-250 v.
MT3/AT, output 12-15-20-24-30 v. at 2 a. **25/6**
MT16/AT, output 24 v. at 5 a. **38/6**
MT21/AT, output 12-15-20-24-30 v. at 4 a. **38/-**
Stepdown Transformers, MT4/AT 115/230 v., 150 watts **25/6**
Packing and carriage 5/-.

SCREENED POWER TRANSFORMERS for 200 to 250 v. A.C. input

Output 450/400/0/400/450 v. at 180 mA., 0-4-6.3 v. at 4A, 0-4-5 V. at 4A. two outputs 0-4-6.3 v. at 3A **35/-**
Output 350/300/0/300/350 V. at 200 mA., 0-4-5 V. at 3A, 0-4-6.3 V. at 3A. and two outputs 0-4-6.3 V. at 4A. **35/-**
Packing and carriage 10/- per transformer.

A.C. ELECTRIC MOTORS



REDUCTION GEAR MOTOR
Approx. 8 watts 5 minute rating on 230V. A.C. output. 4-stage gearbox provides output shaft speed of approx. 14.5 r.p.m. with a torque exceeding 1 foot-pound. With voltage reduced to 180V. the motor will operate continuously. Shaft ¼in. dia. Overall dimensions 2½in. × 3¼in. × 3in.
PRICE **12/6**
P.P. 2/6.

VARIABLE AUTO-TRANSFORMERS Type B-2

Input 230 v. A.C. 50-60 c/s. Output adjustable from 0 to 260 v. at a maximum current of 2.5 amps. Scale graduated in volts. Dimensions: 5½in. dia. × 4¼in. high. Fixing: Three 2in. dia. holes on a pitch circle of 5½in. dia. PRICE, brand new **£5 19 6**
Packing and carriage 11/6.

POWER UNITS TYPE W8856A

This is a Navy version of Type 3 Power Unit. 19in. rack mounting. Input 230 v. Fully smoothed H.T. output can be adjusted from 180 to 270 v. at 80 mA. by means of primary taps. L.T. output 6.3 v. A.C. at 4 amps. A.C. voltmeter monitors A.C. mains input and, with key switch depressed H.T. output. PRICE second-hand, in good condition, **£3/10/-.** P.P. 15/-.

EX P.O. MAGNETIC COUNTERS

2300Ω Coil, energised by 24 v. D.C. four digit electromagnetic fast acting counters (non-cancelling type) counting up to 9999. Perfect condition, **6/6.** P.P. 1/6.

MINIATURE VOLTMETERS—BATTERY INDICATORS

Reading from 4.5 to 8 v. D.C. (suppressed zero). 1½in. dia scale, flange mounted **15/-**
Packing and carriage 1/6.

REMANENT TELEPHONE CROSSBAR RELAYS

The relay consists of 5 cross-bar Units of 8 make contacts each, operated by separate 820Ω coils and one 1,000Ω main coil of the P.O. 3000 Type. The latter is fitted with two sets of auxiliary changeover contacts.
PRICE, brand new (p. & p. 5/-) **35/-**

5WW—170 FOR FURTHER DETAILS.

TRANSISTORS

MULLARD:

OC28 .... 17/6	OC71 .... 5/-	OC78D .. 7/-
OC35 .. 15/-	OC72 .... 8/-	OC81 .... 7/-
OC44 .... 6/-	OC75 .... 6/-	OC81D .. 7/-
OC45 .... 6/-	OC76 .... 6/-	OC139 .... 12/-
OC70 .... 5/-	OC78 .... 7/-	OC170 .... 8/-

SPECIAL OFFER

Set of two OC81 and one OC81D 12/6
Mullard Power Transistor GET573, 25 watts dissipation when mounted on a heat sink. 20/- each. Matched pair 35/-
R.C.A.: 2N410, 465 kc/s I.F. 4/3
2N412, 540 to 1,600 kc/s. converter 4/3
MICRO-ALLOY:
MAT101 (up to 60 Mc/s.) 8/6; MAT121 (120 Mc/s.) 8/6
NEWMARKET: VS 30/20 10/-; V30/30P 12/-
TEXAS N-P-N: 2S002 20/-; 2S004 20/-; 2S006 20/-; 2N697 15/-.
SURPLUS TRANSISTORS: Substandard: OC44 2/9; OC45 2/9. Spot Transistors: Red 2/8. White 2/8. Yellow 1/10. Green 1/6.

LUCAS SILICON JUNCTION CHARGING RECTIFIERS

2DS500, full wave bridge connected, 24/36 v. r.m.s. 5A D.C. £2.

ZENNER DIODES

2.25 watts: 4.25±.3 V. (VR425); 4.75 V. ±.3 V. (VR475); 5.25 ±.3 V. (VR525); 5.75 V. ±.35 V. (VR575); 6.25 ±.35 V. (VR625); 7.0 V. ±.6V. (VR7B); 9.0 ±.6 V. (VR9B), **ALL AT 6/6 each.**
10.0 V. ±.6 V. (VR10B); 110 V. ±.6 V. (VR11B), **ALL AT 7/- each.**
25 watts: SZ68BR, stud mounted (Stud Cathode), 68 V. ±10%. Zenner current 330 mA., 7/6 each.

SILICON JUNCTION RECTIFIERS

Wire Ended

2E8 (I.R.C.), 800 p.i.v., 200 mA. D.C. 3/6
MULLARD BY100, 700 p.i.v., 450 mA. D.C. 8/-
LUCAS DD058 sub-miniature, 800 p.i.v., 500 mA. 12/6

KLYSTRONS

2K25 .... £4	723A/B .. £3	KRN6/2 .. £4
2K28 .... £10	726A £4	KRN6/3 .. £5
2K33 .... £45	726B £5	K301 .... £4
2K41 .... £30	5721 .... £50	SAL39 £200
2K45 .... £7	5836 .... £25	SAL89 £200
2K48 .... £18	6470 .... £75	V235A/1K £10
3K23 .... £60	CV67 .... £5	VA220E .. £35
417A £2	CV2116 .. £10	
707B £3	KRN2A .. £4	

CATHODE RAY TUBES

3AP1 ....22/6	5BP7 ..100/-	VCR97 .. 40/-
3FP7 .... 12/-	5UP7 .... 60/-	VCR138 .. 50/-
3JP7 ....100/-	7BP7 .... 15/-	VCR138A 60/-
5ADP7 .. 60/-	913 .... 50/-	VCR517B
5CP1 .... 30/-	09D 80/-	or C .. 40/-
5FP7 .. 12/6	09J 80/-	

Tube Base: 3AP1 1/6; 5FP7, 7BP7, 913 1/-; 3FP7, 3JP7, 5CP1, 5BP7 3/6; ACR10, 09D, 09J 2/6; 5UP7 3/-; VCR97, VCR138, VCR517 3/6.

SIGNAL DIODES

OA81 .... 1/6	IN38A .. 4/-	CV112 .. 8/-
IN21 .... 4/-	IN70 .... 4/-	CV442 .. 1/3
IN23 .... 4/-	IN72 .... 4/-	CV2226 .. 30/-
IN42B .. 4/6	IN81 .... 4/-	CV2258 .. 30/-
IN23C 8/-	CK708 .. 4/-	CV2355 ..100/-
IN25 .... 9/-	CV101 .... 5/-	SX642 .. 3/6
IN26 ....40/-	CV102 .... 5/-	SX643 .. 15/-
IN28 ....20/-	CV103 .... 5/-	SX781 .. 4/6
IN34A .. 4/-		

MAGNETRONS

2J27 .... £3	5J26 .... £25	M551 .... £25
2J31 .... £5	725A £3	JP9-7A £12/10
2J48 .... £10	M501 .... £8	JPT9-60 .. £40
2J50 .... £5	M502A .. £35	JP9-80 .. £25
2J54 .... £5	M508 £12/10	JP9-250 .. £25
4J31 .... £35	M518 £12/10	JP9-15 £12/10
4J50 .... £35	M518A .. £35	CV991 to
4J52A ... £25	CV370 £12/10	CV994 .. £7
4J53 £12/10	M521 .... £35	

SELENIUM RECTIFIERS

MINIATURE TUBULAR WIRE ENDED, D1601. Capacative load: 140 V. r.m.s. in., 140 V. D.C. at 15 mA. Resistive load: 230 V. r.m.s. in., 90 V. D.C. at 15 mA. 2/- each.

CONTACT COOLED: 230 V. r.m.s. input, 300 mA. D.C.; Half Wave 3/6; Voltage Doubler 4/-.
HT and EHT TUBULAR

16HT40, 540 V. r.m.s., 6 mA. D.C. 4/-
T16HT56, 750 V. r.m.s., 6 mA. D.C. 4/-
T36EHT30, 810 V. r.m.s., 2 mA. D.C. 5/-
T36EHT60, 1080 V. r.m.s. 2 mA. D.C. 5/6
T36RHT90, 2430 V. r.m.s.. 2 mA. D.C. 6/6

"ELECTRON" OUTDOOR ROD AERIAL

3 strong tubular light alloy sections 3ft. long each on an insulated aerial base fitted with wall mounting bracket. Complete with down lead. PRICE, brand new, 15/-. P.P. 5/-.

OUR NEW PRICE LIST OF VALVES AND TUBES IS READY AND AVAILABLE UPON SENDING 6d. STAMP.

FULLY GUARANTEED QUALITY UNUSED VALVES

OA2 .. 6/-	5B/258M .. 6/-	6F6G .. 5/-	10P13 12/6	30F5 .. 8/6	2050.. 12/-	AZ41.. 6/6	EBC33 6/-	EL41 7/3	ML6 .. 6/-	QV06-20 .. 27/6	UU7 8/-
OA3 ..11/-	6F7 .. 5/-	10P14 12/-	30L15 12/-	2051.. 6/-	B12H 35/-	EBC41 6/9	EL42 8/-	N78 .. 15/-	R10 .. 15/-	UU10 8/-
OB2 .. 6/-	5D21 70/-	6F13 6/6	11E2 20/-	30P19 14/-	4043C 25/-	B65 .. 4/6	EBC81 6/6	EL71 17/-	N308 12/6	R17 .. 8/-	UY41 5/6
OB3 8/-	5D/100A .. 1400/-	6F17 6/-	11E3 20/-	30PL1 10/6	5514.. 50/-	B84A 30/-	EBC90 4/-	EL81 8/6	N8P1 25/-	R18 .. 7/6	UY85 5/-
OC3 .. 5/6	5R4GY 9/-	6F32 3/-	12A6 8/-	35L6GT 7/-	5517.. 6/-	B86 40/-	EBC91 6/-	EL83 7/-	N8P2 22/-	R19 .. 7/-	VGT128
OD3 .. 5/-	5U4G 5/-	6F33 5/-	12AH7GT	35W4 5/-	5651.. 8/-	BT19 30/-	EBF80 6/6	EL84 5/-	P41 .. 8/-	RL18 12/6	10/-
OZ4 .. 5/-	5U4GB 6/-	6H6 .. 1/6	5/-	35Z4G 5/-	5654.. 8/-	BT35 30/-	EBF83 7/6	EL85 8/-	PABC80 7/-	S130 12/6	V1507 5/-
1A3 .. 3/-	5V4G 8/-	6J4 9/-	12AH8 11/-	35Z4GT 6/-	5663.. 7/-	BT45 200/-	EBF89 6/9	EL86 7/6	PC97 8/6	S130P 15/-	VP41 5/-
1A5GT 5/-	5Y3G .. 4/-	6J5 5/-	12AT6 5/-	35Z5GT 6/-	5670.. 10/-	BT79 30/-	EBL1 11/-	EL90 6/-	PCC84 5/6	SC1/1000 .. 40/-	VR21 3/6
1A7GT 8/-	5Y3GT 5/-	6J6 .. 3/6	12AT7 4/-	42 .... 5/-	5687.. 8/-	BT83 60/-	EBL21 11/-	EL821 6/-	PCC85 7/-	SC1/1400 .. 40/-	VR56 3/-
1B27 40/-	6J7G 5/-	12AT7WA	50B5 .. 8/-	5691.. 25/-	C1B 22/6	EC52 4/6	EM34 9/6	PCC88 10/6	SP2 .. 3/6	VR57 6/-
1B63A 70/-	5Z4 .. 9/-	6K6GT 6/-	6/-	50C5 .. 6/6	5696.. 6/-	C1C .. 5/-	EC90 2/6	EM81 7/6	PCC89 10/-	SP41 4/-	VR66 3/-
1C5GT 7/-	5Z4GT 8/-	6K7 .. 5/-	12AU6 6/-	50L6GT 6/6	5702.. 15/-	C1K .. 40/-	EC91 5/-	EM84 8/-	PCF80 5/6	SP61 4/-	VR75/30
1D5 .. 7/6	6A6 .. 6/-	6K7G 2/-	12AU7 5/-	53KU 9/-	5718.. 7/6	C3JA 80/-	EC92 6/6	EM85 9/-	PCF82 6/6	SP81 4/-	11/-
1G6GT 7/-	6A8G .. 6/-	6K8 .. 8/-	12AV6 7/-	57 .... 6/-	5725.. 10/-	C16J 200/-	ECC40 9/-	EN31 10/-	PCF86 8/-	SP91 4/-	VR78 3/-
1H5GT 8/-	6AB4 6/6	6K8G 4/-	12AV7 8/-	71A .. 7/-	5726.. 7/-	CL33 9/-	ECC81 4/-	EN32 10/-	PCL81 9/-	TH233 7/-	VR92 2/-
1L4 .. 2/6	6AB7 4/-	6L6 .. 9/-	12AX7 6/-	75 .... 5/6	5727.. 10/-	CY31 6/6	ECC82 5/-	EN91 6/-	PCL82 6/6	TP25 5/-	VR99A 8/-
1L6 .. 17/6	6AC7 3/-	6L6G 6/-	12AY7 10/-	76 .... 5/-	5749.. 9/-	DA30 20/-	ECC83 6/-	EN92 15/-	PCL83 8/3	TT11 3/-	VR101 12/6
1N5GT 8/-	6AF4 11/-	6L7 .. 5/-	12B4A 9/-	77 .... 5/-	5751.. 11/-	DA41 30/-	ECC84 6/6	EY51 7/-	PCL84 7/-	TT15 35/-	VR102 10/-
1R5 .. 5/-	6AG5 2/6	6L18 .. 8/-	12BA6 6/-	80 .... 6/-	5763.. 10/-	DA100 80/-	ECC85 6/6	EY81 9/-	PCL85 7/6	TT21 32/-	VT4C 20/-
1S4 .. 5/-	6AG7 6/-	6N7 .. 6/-	12BE6 5/-	83 .... 8/-	5787.. 10/-	DAC32 8/-	ECF80 10/-	EY84 7/6	PCL86 9/-	TZ40 30/-	VT52 3/-
1S5 .. 4/6	6AH6 11/-	6Q7G 6/-	12BH7 8/-	83V .. 7/6	5814.. 9/-	DAF91 4/6	ECC91 3/6	EY86 5/6	PEN4A 7/6	U10 .. 8/-	VT501 3/-
1T4 .. 3/-	6AK5 5/-	6R7 .. 6/-	12BY7 10/-	85A2 .. 8/6	5840.. 10/-	DAF92 6/-	ECF80 7/6	EY91 3/-	PEN45 7/-	U12/14 8/-	VU39 5/-
1U4 .. 5/-	6AK6 7/-	6S7 .. 8/-	12C8 .. 3/-	90AV 15/-	5879.. 12/-	DAF96 6/-	ECF82 7/-	EZ40 5/6	PEN45DD .. 12/-	U22 7/6	VU111 5/-
1U5 .. 6/-	6AK8 7/-	6S8GT 5/-	12E1 20/-	90C1 8/-	5949 400/-	DDL4 4/-	ECH21 10/-	EZ41 6/6	PEN46 6/-	U24 12/6	VU120A
1X2A .. 7/-	6AL5 .. 3/-	6S8G 5/-	12H6 3/-	95A1 5/6	5965.. 5/-	DET24 70/-	ECH35 10/-	EZ80 5/6	PEN453DD .. 10/6	U25 11/-	10/-
1X2B 7/-	6AM4 18/6	6S8H 3/-	12J5GT 3/-	150B3 10/-	5998.. 15/-	DF33 8/-	ECH42 8/-	EZ81 4/6	PL36 8/-	U191 11/-	W81M 6/-
2C26A 5/-	6AM5 2/6	6S8J 8/-	12J5WGT	211 30/-	6005.. 7/6	DF91 3/-	ECH81 6/-	EZ90 4/-	PL38 16/-	U251 12/6	X66.. 8/-
2C39A 80/-	6AM6 4/-	6SK7 4/6	6/-	267B 60/-	6060.. 6/-	DF92 2/6	ECH83 7/6	FW4/500 7/-	PL81 7/-	U281 13/-	X65.. 5/6
2C40 70/-	6AQ5 6/-	6SL7GT 5/-	12J7GT 7/6	220TH 5/-	6073.. 7/6	DF96 6/-	ECL80 6/-	G24H 15/-	PL82 5/6	U282 14/-	X66.. 8/-
2C42 25/-	6AR6 6/-	6SN7GT 4/6	12K7GT 7/-	416B 240/-	6080.. 25/-	DH63 6/-	ECL82 7/6	G150/2D .. 10/-	PL83 6/-	U301 12/-	Z63.. 9/-
2C43 60/-	6AS6 .. 5/-	6SQ7GT 5/-	12K8 10/-	705A 15/-	6098.. 12/-	DK32 8/-	ECL83 10/-	GM5B 15/-	PM84 10/-	U403 7/-	Z66.. 15/-
2C46 30/-	6AS7G 22/6	6ST7 8/-	12Q7GT 5/-	715A 30/-	6101.. 7/-	DK40 11/-	ECL86 10/-	GS18 15/-	PL500 16/-	U801 20/-	Z319 12/-
2C50 30/-	6AT6 4/-	6SU7 3/-	12SA7 5/-	715B 60/-	6110.. 20/-	DK91 5/-	EF22 7/-	GT3 15/-	P8G8 8/-	U8C1 20/-	Z700U 5/-
2C51 12/-	6AU6 7/-	6SU7GT	12SC7 4/-	715C 70/-	6135.. 10/-	DK92 6/6	EF36 4/6	GU50 25/-	PT15 10/-	UABC80 5/-	Z800U 20/-
2C52 12/-	6AV6 6/- 10/-	12SG7 3/-	721B 25/-	6136.. 9/-	DK96 6/6	EF37A 8/-	GZ30 10/-	PX4 15/-	UAF42 8/-	CV32 80/-
2CW4 14/-	6B7 .. 5/-	6T8 .. 6/-	12SH7 3/-	807 .. 9/-	6146.. 27/6	DL33 7/-	EF39 4/-	GZ32 10/-	PX25 10/-	UBC41 6/6	CV413 10/-
2D21 6/-	6B8G 2/6	6U4GT 10/6	12SJ7 5/-	813 .. 55/-	6147.. 17/-	DL68 10/-	EF40 9/-	GZ34 10/-	PY33 10/-	UBC81 7/-	CV434 20/-
2E26 30/-	6BA6 4/9	6U7G 10/-	12SK7 5/-	814 .. 20/-	6186.. 15/-	DL69 12/6	EF41 6/9	GZ37 9/-	PY80 5/6	UBF80 6/6	CV465 5/6
2X2 .. 3/-	6BE6 5/-	6V6 .. 9/-	12SL7GT	815 .. 40/-	6463.. 7/-	DL91 5/-	EF42 6/-	HF93 6/-	PY81 5/6	UBF89 7/-	CV466 5/-
2X2A 7/-	6BH6 7/-	6V6G 4/- 7/6	829B 50/-	6621.. 10/-	DL92 5/-	EF80 5/-	HL2 .. 3/-	PY82 5/-	UBL21 11/-	CV467 5/-
3A4 .. 4/-	6BJ6 8/-	6V6GT 5/6	12SN7GT	832 .. 20/-	7586.. 22/6	DL93 4/-	EF85 6/-	HL2K .. 3/-	PY83 6/-	UCC84 9/-	CV468 5/-
3A5 .. 7/-	6BQ7A 8/-	6X4 .. 4/- 7/6	832A 45/-	7895.. 22/6	DL94 5/6	EF86 6/-	HL23 6/-	PY88 8/6	UCC85 6/6	CV469 8/6
3A/141A 35/-	6BR7 11/6	6X5G 4/6	12SQ7 10/-	833A 260/-	8020 20/-	DL95 6/6	EF89 4/6	HL41DD 9/-	PY800 8/6	UCF80 9/6	CV472 5/-
3B7 .. 5/-	6BR8 5/-	6X5GT 5/6	12SR7 5/-	838 .. 12/-	9002.. 5/6	DL96 6/-	EF91 2/-	HY90 5/-	PY801 8/6	UCH21 8/6	CV473 12/6
3B24W 12/-	6BW6 9/-	6Y6G 6/-	12SY7 6/-	872A 35/-	9003.. 7/6	DM70 5/-	EF92 2/-	KT2 .. 5/-	PY802 8/6	UCH42 7/-	CV474 10/-
3B28 15/-	6BW7 9/-	6Z4 .. 5/-	13D3 .. 8/-	884 .. 10/-	9004.. 2/6	DY86 8/-	EF94 7/-	KT8 25/-	PY803 8/6	UCH81 7/-	CV476 5/-
3C45 30/-	6C4 .. 2/6	7B7 .. 8/-	19AQ5 5/-	931A 60/-	9006.. 2/6	DY87 5/-	EF95 5/-	KT32 8/-	PY81 8/6	UCH42 7/-	CV2101 7/-
3CX100A5 100/-	6C5GT 6/-	7C5 .. 10/-	19BG6G	954 .. 5/-	A207 80/-	E92CC 7/-	EF96 2/-	KT33C 6/-	PZ30 15/-	UCL82 8/-	CV2102 10/-
3D6 .. 4/-	6C6 .. 4/-	7C6 .. 7/- 10/-	955 .. 3/-	A1820 20/-	E180CC .. 10/-	EF98 10/-	KT41 7/6	QP25 5/-	UCL83 10/-	CV2103 7/-
3E29 50/-	6C6G 7/-	7C7 .. 5/-	20L1 14/-	956 .. 2/-	AC/P4 7/6	E180F 15/-	EF184 8/-	KT44 5/-	QQV02-6 .. 45/-	UF41 7/6	CV2105 8/-
3Q4 .. 6/6	6CD6G 17/-	7F8 .. 8/6	20P1 14/-	957 .. 5/-	AC5/ .. 10/-	E181CC .. 10/-	EH80 6/-	QQV03-10 .. 35/-	UF42 7/-	CV2260 5/-
3Q5GT 7/6	6CH6 6/-	7H7 .. 8/-	25A6G 5/-	PENDD 8/-	AC6/PEN .. 10/-	EH90 7/3	KT66 15/-	Q85-60 .. 20/-	UF80 6/6	CV2341
3S4 .. 5/-	6CL6 10/-	7Q7 .. 7/-	25L6GT 8/-	959 .. 8/-	E182CC .. 10/-	EK90 5/-	KT88 20/-	QS1200 12/-	UF85 7/-	200/-
3V4 .. 5/6	6CW4 14/-	7Y4 .. 7/-	25Z6G 6/6	991 .. 7/-	E810F 15/-	EL32 3/-	KTW61 7/-	QV03-12 .. 20/-	UF89 6/-	CV4003 10/-
4B26 35/-	6D4 15/-	8D2 .. 3/6	25Z6GT 8/6	1616.. 7/-	AR8 .. 6/-	EL34 10/-	L63 .. 6/-	QV04-7 10/-	UF89 6/-	CV4004 10/-
4D1 .. 4/-	6DS4 15/-	9BW6 7/-	27M1 60/-	1619.. 7/-	ARP3 3/-	EL36 10/-	MH4 .. 5/-	UF92 12/-	UL41 7/6	CV4014 8/-
4E27 60/-	6EV5 12/-	10F9 10/-	28D7 .. 7/-	1625.. 6/-	ARP12 3/6	EL37 17/6	MHLD6 .. 10/-	UL84 6/-	CV4024 6/-
			28D7W 15/-	1626.. 3/-	ATP4 5/-	EABC80 6/-	EL38 17/6	UU5 .. 7/-	CV4025 7/-
			30C15 10/-	1629.. 6/-	AZ1 .. 9/-	EAC91 4/-	EL84 5/-	UU6 .. 11/6	CV4046 50/-
				1635 .. 12/-	AZ31.. 8/-	EAF42 8/6	EL86 12/6		

When ordering by mail, please add 2/6 in £ to cover handling and postage. **MINIMUM CHARGE 1/5.**

WE WISH TO BUY VALVES, KLYSTRONS, MAGNETRONS, etc. Please offer us your surplus stock.

Z. & I. AERO SERVICES LTD.

RETAIL BRANCH: 85 TOTTENHAM COURT ROAD, W.2. Tel.: LANgham 8403

Please send all correspondence and Mail Orders to OUR NEW ADDRESS OF HEAD OFFICE AT: 44a, WESTBOURNE GROVE, LONDON, W.2. Tel.: PARk 5641/2/3

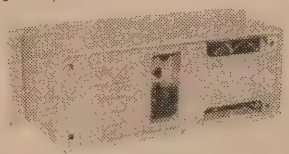
VALVE VOLTMETER TF428. 10 to 150 v. in five ranges at 2% F.S.D. with probe **£15/10/-** each, post 12/6. CT54 Valve V. 2.4 to 480 volts with multiplier 2,400 v., resistance 0.1 to 10K, five ranges, **£30.**

DE-ICER, Controller Mk. 3. Contains 10 relays D.P. change-over heavy duty contacts, 1 relay 4P, C/O. (235 ohms coil). Stud switch 30 way relay operated, one five way ditto, D.C. timing motor with Chronometric governor 20-30 volts 12 RPM, geared to two 30-way stud switches and two Ledex solenoids, 1 delay relay, etc., sealed in steel case, size 4 × 5 × 7in., **£3** each, post 5/-.

BC640 MODULATOR UNIT. 2 × 811's, mod. transformer and fil., trans. complete mod. unit fits 19in. rack 50 watts, **£5/10/-,** carr. £1.

SIGNAL GENERATORS. TS-13AP freq. 9305-9445 mc/s. **£25** each, carr. £1. 10 cM, BC1277 **£20,** carr. 25/-. RCA 710A 370-560 mc/s. **£30,** carr. £1. TF 144G 85 Kc/s. to 25 mc/s. **£25,** carr. 25/-. Test set UPM 1 A & B comprising of Signal Gen., Wavemeter, Oscilloscope and Video amp., in one unit freq., 155/235 mc/s. and 460-570 mc/s., 115 and 230 V. A.C., new **£35** each, carr. £2. Dynamotor test set TS 414A **£30,** carr. 30/-.

TRANSFORMERS (Isolation). 230 to 115 volts 300 va., **£3** each, 5/- post. 230-115 volt auto 750 watts **£4,** carr. 10/-. 110-230, 275-0-275 at 125 ma., 6.3 at 4 amps **22/6** each, post 5/-. 230v., 6.3 v. × 3 at 3 amps **21/-** each, post 4/-. 230 v., pri 1850-0-1850 at 500 ma., **£5** each, carr. 15/6. 230 v., pri. 6.3 × 3 at 3 amps **20/-** each, post 4/-.



POWER & SMOOTHING UNITS. 100-250 v., A.C., input 24 v., D.C. at 3 amps or 12 v. twice at 3 amps, continuous rating, switched fused, etc. In metal case 19 × 7 × 7in. Smoothing two large chokes and 0-1 ma. meter scaled 0-50 volts. **£7/10/-** (pr.), 15/- carr.

GEARED MOTOR. 24 v. D.C., 1.4 r.p.m., reversible with tw micro switches inside gear box, silent operation. **£2** each, post 5/-

POWER SUPPLY unit for SENDER No. 36 110-240 A.C. input contains Speech amplifier. Modulator and External power supplies, 3xFW4/500 rectifiers provide H.T. for R.F. unit Speech amplifier 6C5G, Modulator 2x6C5G and 2 × 807 output. Size 24 × 16 × 14 inches. Housed in a fine oak case with circuit. Wt. 110 lbs. As new **£6/12/6,** carr. 30/-.

CONVERTERS. Type 8 a., 24 v. D.C., 115 v. A.C. at 1.8 amps. 400 cycles. 3-phase. **£5** each, carr. 7/6.

CONDENSERS. 1 mfd., 20 kv., **£6/12/6** each, post 12/6 each. 0.25 mfd., 32,500 volts Wkg. **£5** each, post 12/6 each. 150 mfd., 290 volts A.C. **£5** each, post 12/6. 50 mfd. 330 volts A.C., **40/-,** post 4/-. 10 mfd. 2 Kv. **27/6,** post 5/-. 10 mfd., 1,000 v. **12/6,** post 2/6. 8 mfd., 1,500 volts **17/6,** post 2/-. 8 mfd., 1,200 volts **12/6,** post 3/-. 8 mfd. 600 volts **8/6,** post 2/6. 0.1 mfd. 3 kv. **4/-,** post 1/6. 0.25 mfd. 2 kv. **4/-,** post 1/6. Vacuum condenser 50 pf. 32 Kv. **30/-,** post 1/6. 6 pf. 20 kv. **22/6,** post 1/6. All the above are new in cartons.

RECEIVER C52 less outer case, good condition. Freq. 1.75-16 mc/s on three bands complete with all valves. **£6/19/6,** post 12/6.

AR88 PORTABLE KITS. Fine well made box for the receiver and spares with original speaker. Vibrator unit 6 volt D.C., 14 valves lamps headset shockmounts cables, brand new, **£7/12/6,** carr. 25/-.

POWER SUPPLY UNIT PN-12.B. Ex BC 640, 230 volts A.C. input, fits 19in. rack, 800 volts D.C. @ 350 ma., 395 volts 300 ma., 4×5U4G valves, 2 chokes 9 H., 300 ma., 2×10 mfd. oil filled caps, **£6/10/-** each, carr. £1.

VARIABLE POWER UNIT (VARIAC) 0-230 volts 9 amps with meter 0-250 v. with on/off switch, mounted in 19in. rack, **£15/10/-,** carr. 12/6.

CIRCUIT BREAKERS, 3 pole 150 amps. 600 v. A.C., **£3** each. Made by GEC, U.S.A., post 6/-.

RELAY UNIT. G.P.O. 600 types 5 relays 150 ohm 1 set C/O., and 5 relays 400 ohm 2M., 1 set C/O., in metal box 8×6×5 inches, **£2,** post 5/-.

AR88 SPARES. 14 valves, headphones and 3 pilot lamps, new original cartons, **£3/10/-** each, post 2/6.

TUBES. 5CP1a, 30/- each, post 3/-. 3BP1, 25/-, post 2/6. 814, 17/6, post 2/-. VT4C, 17/6, post 2/-. CV1526, 25/-, post 2/-. VT158, 50/-, post 3/-. CV370, **£3,** post 4/-. 4J50, **£10.**

ROTARY CONVERTERS. 220 D.C. input, 230 volts A.C., output at 11 amps. Continuous rating, **£25** each, carr. 50/-.

FASIMILE KEYER UNIT KY 75 SRT. 115/230 volts, **£25** ea.

MODULATOR MD 168/UX (for the above keyer), **£12/10/-.**

FSK UNIT. ATE Ltd. 230 volts, **£12.**

RCA FSK UNIT. 115/230 v. A.C., **£17/10/-.**

SMALL GEARED MOTOR. 24 volts D.C., 70 r.p.m., 19/6, p. 2/-

APN1 METERS. Circcale 0-180 deg. (make rev. counter, **17/6,** post 2/-.

LORAN APN4 INDICATORS with 5CP1 tube and shield 27 valves. **£6** each, carr. 25/-.

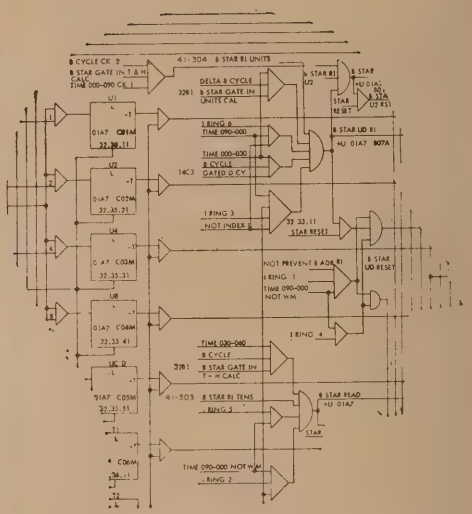
List available 6d. S.A.E. for all enquiries.

W. MILLS

3-B TRULOCK ROAD, TOTTENHAM, N.17

Phone: Tottenham 9213 & 9330

5WW—172 FOR FURTHER DETAILS.



DO YOU HAVE A HEAD FOR COMPUTERS?

A head for the specialised knowledge it takes to be an IBM Data Processing Customer Engineer. A head for diagnosing computer troubles—and correcting them before they actually occur.

As a Data Processing Customer Engineer with IBM you will be required to install electronic and electro-mechanical data processing equipment, and ensure that it operates at maximum efficiency at all times.

An IBM Customer Engineer must have the knowledge and confidence which enables him to work easily with all levels of customer management, and with IBM analysts and programmers. He must be young (21-29) and possess the initiative and drive to keep pace with one of the most rapidly expanding companies in the country.

He must already have a basic knowledge of electronics (H.N.C. Electrical, C and G 47 or Services Radar Servicing Course), but IBM will further this knowledge with their own training programme. Commencing salary will be by arrangement, and there is no limit to the prospect of advancement in the exciting field of Customer Engineering with IBM.

There are posts available in most major cities and towns throughout the country. If you feel that here is the opportunity you have been looking for, write at once to: Mr. I. F. Bush, Personnel Selection Department, IBM United Kingdom Limited, 101 Wigmore Street, London, W.1. (Quoting reference CE/WW/733).

IBM

IBM IS EXPANDING

BB.92

5WW—173 FOR FURTHER DETAILS.

CLASSIFIED ADVERTISEMENTS

Rate 9/- for 2 lines or less and 4/6 for every additional one or part thereof, average lines 6 words. Box Numbers 2 words plus 1/-. (Address replies: Box 0000 c/o "Wireless World" Dorset House, Stamford St., London, S.E.1.) Trade discount details available on application. Press Day March 1964 issue, Friday, February 14th. No responsibility accepted for errors.

SITUATIONS VACANT

D.S.I.R.

NATIONAL PHYSICAL LABORATORY, Teddington, Middlesex.

ASSISTANT Experimental Officer/Experimental Officer for Autonomics Division to design and build variety of electronic instruments for research in neuro-physiology, also to build small special purpose electronic computing devices for solving specific physiological problems.

QUALIFICATIONS: Science degree, Dip. Tech., or H.N.C. in an appropriate subject. Thorough practical knowledge of transistor circuitry and experience of electro-mechanical devices required.

SALARY: A.E.O. £676 (age 21) to £898 (age 26 or over) to £1,098. E.O. (minimum age 26) £1,209-£1,481.

APPLICATION form from Director at above address quoting AA/095. Closing date 6th February, 1964. (5.) [2677

TELECOMMUNICATIONS ENGINEERS

REQUIRED by the East African Posts and Telecommunications Administration, in the following categories, on contract for one tour of 24 months in the first instance. Salaries (including overseas addition) range from £1,725 to £1,956 a year. Gratuity payable at rate of 25% of total salary drawn. Disturbance allowance—£200 for a married man, £100 if singie—payable on first appointment. Children's educational allowances, free passages, liberal leave on full salary.

ASSISTANT ENGINEERS, GRADE I.

CANDIDATES aged between 28 and 45 years should possess a City & Guilds Intermediate group course certificate, and in addition a pass in either Radio Grade 2, Telegraphy Grade 2 or Line Transmission Grade 2. They must also have had sound experience in one of the following fields:—

RADIO—A thorough knowledge of the installation and maintenance of H.F. and V.H.F. radio communication equipment. A knowledge of carrier and telegraph equipment would be an advantage.

V.H.F. SPECIALIST—As for Radio category, but it is essential that candidates should have had practical field experience in the installation of multi-channel V.H.F. equipment and associated carrier and telegraph equipment.

UNDERGROUND CABLE PLANNER—A thorough training in line plant planning methods, field survey work for local and junction cables, the preparation of schematic and fundamental plans and jointing schedules is essential. A knowledge of the preparation of overhead distribution schemes would be an advantage.

ENGINEERING INSTRUCTOR, GRADE I.

CANDIDATES aged between 28 and 45 years, must have a thorough knowledge and practical experience of telephone heavy open wire route survey construction and maintenance, and of Advice Note construction work including the fitting of subscribers' apparatus. Teaching experience is highly desirable.

ENGINEERING FIELD TRAINING OFFICERS

CANDIDATES aged between 28 and 45 years must have had 10 years' experience in telecommunications engineering, and a thorough knowledge in one or more of the following fields:—

AUTOMATIC TELEPHONY—non-director systems, including power plant; 2V.F. signalling equipment; auto-manual switchboards; test desk operation and control; U.A.X. 12 and 13 and P.A.B.X. systems.

TRANSMISSION—3-channel and 12-channel carrier systems; 24-channel V.F. telegraph systems and radio group combining equipment; V.H.F. radio equipment and Telex working.

GENERAL AREA MAINTENANCE—subscribers' apparatus; overhead and underground line plant; P.A.B.X. systems; U.A.X. 12 and 13; and maintenance control duties.

APPLY to Crown Agents, 4, Millbank, London, S.W.1, for further particulars, stating age, name, brief details of qualifications and experience, and quoting reference M2/52098/WF. [2685

SENIOR DEVELOPMENT ENGINEER

REQUIRED to take part in expanding programme of development work of leading Television Manufacturer concerned with Export Television. Suitable applicant must have at least 5 years similar experience. Salary will be commensurate with qualifications and experience.

PLEASE apply, quoting Ref. No. A.4247, to: THE Personnel Manager, Ferguson Radio Corporation, Ltd., Gt. Cambridge Rd., Enfield, Middx. [2679

HAWKER SIDDELEY AVIATION LIMITED
DE HAVILLAND DIVISION

BROUGHTON, CHESTER

H.S. 125 EXECUTIVE JET AIRCRAFT

SENIOR ELECTRONICS SYSTEMS DESIGNER

A vacancy exists for a Senior Electronics Systems Designer with several years experience in Aircraft Electronic Systems design who is capable of dealing with the co-ordination and design of complete Radio/Navigation, Flight Director and Auto-pilot Systems employing the latest American Lightweight Equipment (ARINC) to suit individual customers' operational requirements in Light Executive Jet Aircraft.

Applications for this position should be addressed to the Chief Development Designer.

INTERMEDIATE ELECTRONICS SYSTEMS DESIGNERS

Several vacancies exist for Intermediate Designers with Aircraft Radio and Electronic experience who are keen to take part in the design of systems employing the latest types of equipment to customers' special requirements.

Applications should be addressed to the Personnel Manager.

SENIOR AND INTERMEDIATE DESIGN DRAUGHTSMEN

Applications are invited from Senior and Intermediate Design Draughtsmen with experience in the laying out and design of Structure and Installations for Radio and Electronic equipment, Instrumentation, etc., to customers' special requirements.

Applications should be addressed to the Personnel Manager at the above address, quoting Ref. DC.56/H.

PART-TIME vacancies.

DO you live in the Manchester area? Royal Signals Territorial Army have vacancies for radio operators (4) and radio technicians (2). A hobby with pay and specialist training if required. Apply in person Tuesdays and Thursdays 8-9 p.m., Sundays 10-12 noon to Major Currie at TA Centre, Norman Road, Rusholme, Manchester, 14, or Capt. Griffin, TA Centre, Britannia Road, Sale, Cheshire. [2692

AN OVERSEAS CAREER WITH INTERNATIONAL AERADIO, LIMITED.

TO meet the requirements of constant growth and expansion we invite applications from technicians and engineers for a overseas career in North West and East Africa, the Mediterranean area, the Caribbean, the Arabian Gulf and the Far East. If you have recently completed service in a trade such as Ground Wireless Fitter in the R.A.F. or Radio Electrical Artificer in the Royal Navy or have other experience in the maintenance of HP and VHF communications, RTT and navigational aids, we should be interested to hear from you. Successful candidates would normally spend six weeks at our Radio Training School, Southall, Middlesex, before proceeding overseas, but in some cases staff with suitable qualifications and experience may be offered immediate posting. Overseas staff receive a tax-free salary with married and child allowances if appropriate and accommodation, bachelor or married, is provided free; other benefits include generous U.K. leave and membership of an excellent pension and life assurance scheme.

WRITTEN applications, please, to Personnel Officer, 40, Park St., W.1. [0084

RADIO & Television Testers.

FOR City Factory; good rates up to 7/6 per hour; five-day week.

APPLY to Personnel Manager:—

ALBA (Radio & Television), Ltd., Tabernacle St., London, E.C.2. [0012

MINISTRY OF AVIATION, London.

A TECHNICIAN is required for service on a national basis covering the installation, maintenance and operation of various types of machine telegraph and specialised electronic equipment. QUALS. Recognised engineering apprenticeship or equiv. training, O.N.C., appropriate C. & G. Final Certs. or equiv. qualn. required. A knowledge of morse, general signal routine practice and experience in semi-conductor circuits would be an advantage. Applicants should be prepared to do shift work, travel within the U.K. and possibly take up short term duties overseas. SALARY: £941 (at age 26)—£1,002 (at age 28 or over on entry)—£1,119 p.a. Good prospects for promotion and pension. Technical College courses sponsored for suitable candidates. APPLICATION forms from Manager (PE.5289), Ministry of Labour, Professional & Executive Register, Atlantic House, Farringdon St., London, E.C.4. [2671

ELECTRONIC Engineer required for Electroencephalographic Department of The London Hospital, Whitechapel, E.1. Duties include supervision of the maintenance and development of new instruments, as well as assistance with research. Department may be visited by arrangement. Salary dependent on qualifications and experience.—Applications, with names of two referees, to the House Governor immediately. [2676

AWRE

ALDERMASTON

•

Vacancies for
ELECTRONICS MECHANICS

•

Information on —

Rates of pay ** Housing ** Lodging Allowance ** Sick pay ** Superannuation can be obtained on application by post-card, quoting ref. PA/923/45, to

The Industrial Recruitment Officer,
Building F.6.1,
A.W.R.E. Aldermaston,
Berks.

THE UNIVERSITY OF SOUTHAMPTON.
DEPARTMENT of Physics.
TEMPORARY Contract Assistant required to construct and test electronic equipment for satellite instrumentation. Candidates should have had experience with transistorized circuitry. Salary up to £900 per annum, according to age and qualifications. Period of appointment two years. Applications in writing, giving details of age, education and experience and the names of two referees, should be sent to the Secretary and Registrar, The University, Southampton, as soon as possible. [2688

MAIL order manager required.—Central London (Hi-Fi). State experience in confidence.—Box 5192. [0139

SOUND reproduction and acoustics: there are vacancies in a small development laboratory for junior engineers, 20-25 age group, H.N.C. level plus enthusiasm is a basic requirement.—Tel. Kings Langley 2955. [2693

WAR DEPARTMENT, 33, Central Workshop REME, Newark, Notts
TELECOMMUNICATIONS Mechanics for overhaul of wireless equipment, starting range of pay £11/11 to £12/13; progression beyond this according to service and qualification. Five-day 42 hours working week, opportunities for external training and promotion.—Apply to Officer Commanding, 33, Central Workshop REME, Lincoln Road, Newark, or local office the Ministry of Labour, quoting reference 33/CW/1. [0232

OIL exploration.—Holders of H.N.C. with Electronics, or higher qualifications, are offered a permanent career in Geophysics; from headquarters in the U.K. we operate at home and or the continent, but more frequently in remote areas; actively developing methods, mainly electronic, in which your initiative may play its part, add technical zest to a life that can be adventurous; ability to get along with men of other nationalities is of prime importance.—Please write to Box 5218. [0332

INCREASE YOUR INCOME
WIDEN YOUR KNOWLEDGE
MAKE NEW FRIENDS

JOIN THE
ARMY EMERGENCY RESERVE
R.E.M.E.

Wireless and Telecommunication Mechanics with or without previous military service are required as volunteers to train for 15 days in the summer on modern equipments. Generous pay and bounties. For details write

HQ, AER, REME, BROXHEAD HOUSE, BORDON, HANTS.

ELCONTROL LTD.

TECHNICAL,
TEST AND SERVICE ENGINEERS

Young men interested in working on industrial electronic controls and automation devices.

We have vacancies in Technical Department for experimental assistants and in test and service sections. Real enthusiasm with initiative and determination and genuine interest in transistor electronics more important than qualifications. We are interested in young men who have a real urge to invent and experiment but whose lack of these qualifications is perhaps hindering them in their present job. Radio and TV engineers would find work interesting and rewarding—Please send full details in chronological order with salary required to **Managing Director, Elcontrol Ltd., 42, Wilbury Way, Hitchin, Herts.** Age limits we would suggest are from 17—40 but exceptional applicants outside these limits would be considered.

CLOSED CIRCUIT T.V. TESTERS

We invite applications from test engineers, preferably with previous industrial experience on television equipment. Interesting work on TV cameras, camera control units and a variety of monitors including transistor equipment.

Successful applicants will be offered positions on the Company's permanent staff. Salary in line with qualifications and experience. Holiday arrangements will be honoured. Superannuation scheme. Company station transport.

Apply in writing to Personnel Officer,

PETO SCOTT ELECTRICAL INSTRUMENTS LTD.

Weybridge

RADIO engineers, senior and junior electronics engineers required by internationally known organization; candidates must be single, medically fit, prepared to spend periods of up to two years abroad, and be able to accept responsility for the success of projects.
QUALIFICATIONS: Senior posts—B.Sc., H.N.C. or equivalent plus industrial experience. Junior posts—O.N.C. or experience as a first-class skilled radio mechanic.
A knowledge of modern survey techniques is an advantage.
BOX 5268. [2624

A VACANCY exists for the position of engineer at our Head Office in London. Applicants should have had considerable experience in electro-mechanical engineering, sound systems, and electronics should be 25/35 and reached O.N.C. (Electrical Standard). This is an interesting and responsible staff position for a practical man. Those interested are invited to write to—Box 5280. [2682

ELECTRICAL METHODS ENGINEER

A keen young engineer is required who has had a sound practical knowledge of electronics and electro-mechanical systems. This engineer will be expected to design and construct all prototype test gear and advise production on problems of electrical measurements. Applicants should be aged 25-35 and preferably have H.N.C. electrical.

Applications should be addressed to:

The Employment Officer,
S. SMITH & SONS (ENGLAND) LTD.,
Motor Accessory Division,
Cricklewood Works,
Cricklewood, N.W.2.
GLAdstone 3333, Ext. 329

ELECTRONIC ENGINEERS

Men with O.N.C. or equivalent experience required for Test Room on a variety of instruments and equipment for H.M. Services. Suit radio technicians with experience on ground radio and radar equipment. Staff position. Salary in line with qualifications and experience. Holiday arrangements honoured. Superannuation scheme. Company station transport.

Apply in writing to Personnel Officer,
PETO SCOTT ELECTRICAL INSTRUMENTS LTD.
Weybridge

Your NEW YEAR Resolution

That should you decide to change your job, consult the Electronics Appointments Bureau

These are a few of the many advantages:
*WE cater exclusively for the Electronics Industry and are recognized as one of the leading sources of employment.
*WE have a large selection of jobs available immediately.
*WE will make a survey of the area of your choice in London and the Home Counties, for your particular requirements.
*WE do all the spade work, all you need do, is attend the interview.
*OUR service is entirely free to you and are offered in the strictest confidence.
*WE are made aware of many vacancies, before they are advertised.
*WE cater for Engineers, Draughtsmen etc., of all grades.
*WE are pleased to advise you on all types of employment and career problems.

If you have had at least 2 years experience in British Industry and wish to work in London, Home Counties or North America, phone or write:

Electronics Appointments Bureau
22 Gloucester Mansions, Cambridge Circus, W.C.2. COVent Garden 0280

RADIO TECHNICIANS.
REQUIRED by the Government of Northern Rhodesia, Civil Aviation Department, on contract for 1 tour of 36 months in the first instance. Commencing salary according to age and experience in scale rising to approximately £1,578. Gratuity £450 approx. on completion of 3-year contract. Free passages. Liberal leave on full salary. Accommodation provided at low rental. Children's Education Allowances.
CANDIDATES, under 45 years of age, should possess a services trade certificate or M.O.A. certificate of competency and have had sound training in theoretical principles in at least 2 of the following communication, navigational and surveillance systems:—
(1) Medium powered H.F. shift keying; S.S.B. and D.S.B. equipment.
(2) Low and high powered V.H.F., D.S.B. and F.M. equipment.
(3) Medium and V.H.F. non-directional radio beacons visual omni-range, instrument landing system, V.H.F. direction finders, distance measuring equipment.
(4) Radar L. and S. band terminal PPI talk down equipment.
(5) Telephony: Audio and remote control equipment consisting of public address, airport magnetic tape recorder and inter-office telecom. equipment, underground and control cable, impulse and DC switching systems.
(6) Teleprinter telegraphy (torn tape); radio and local circuits consisting of printers autoheads, perforators and line terminating systems.
APPLY to Crown Agents, 4 Millbank, London, S.W.1, for further particulars, stating age, name, brief details of qualifications and experience and quoting reference M2/52209/WF. [2690

A. T. & E. (BRIDGNORTH) Ltd., require Electronic Engineers in the Midlands and Home Counties to install and maintain, after training, Data Transmission Equipment. Experience in Semi-conductors and Telecommunications qualifications desirable. Current driving licence essential. For full details of these posts and form of application.
APPLY to the Personnel Officer, A. T. & E. (Bridgnorth), Ltd., Bridgnorth, Shropshire. [2686

WAR DEPARTMENT

Royal Armament Research and Development Establishment, Potton Island

require

Skilled FITTERS/TURNERS
ELECTRONIC/MECHANICS

Semi-Skilled EXPERIMENTAL WORKERS
(In electronic labs. and magazines)
RANGE WORKERS

Good conditions of service. Paid annual leave in addition to paid Public Holidays.
Paid sick leave scheme.
Prospects of pensionable employment after a qualifying period.

For further particulars apply to:—

The Administrative Officer (W.W.),
R.A.R.D.E.,
Potton Island, Great Wakering,
Southend-on-Sea, Essex.
Telephone: Great Wakering 491

TRAIN AS A TECHNICAL TEACHER!

Well qualified men and women normally aged between 25 and about 45, with good industrial experience can be trained as full time teachers for technical colleges and schools.
ONE YEAR COURSE: SEPTEMBER 1964-JUNE 1965.
will cater for specialists in:—
ALL BRANCHES OF ENGINEERING—MECHANICAL, PRODUCTION, ELECTRICAL etc.
FREE TUITION: MINISTRY OF EDUCATION GRANT SCHEME
Applicants should possess good qualifications such as a University Degree or Diploma, Dip. Tech., H.N.D., H.N.C., F.T.C., Final C.G.L.I., or corporate membership of a professional institution.
For further details write to one of the following:

The Principal,
Garnett College,
Downshire House,
Roehampton Lane, London, S.W.15.

The Director,
Bolton Training College,
Chadwick Street,
Bolton.

The Director,
Training College for Technical Teachers,
Holly Bank Road,
Lindley, Huddersfield.

The Principal,
Wolverhampton Technical Teachers' College,
Wulfruna Street,
Wolverhampton.

Please quote reference S.22.

ELECTRONIC ENGINEER

to service and fit tools on high frequency Plastic Welding machines.

No degree necessary, but knowledge of mechanical engineering an advantage.

Permanent position with good pay and overtime.

Non-contributory pension scheme in operation.

Please write for appointment, stating experience and remuneration required to:

MACANIE LTD.
235/245 Goswell Road, London, E.C.1

TRAINEE
TRANSMISSION ENGINEERS

To fill vacancies in the expanding Engineering Department of the Transmission Division of G.E.C. (Telecommunications) Ltd., we wish to recruit candidates for a 4 or 5 months' course to commence in mid-1964. This course will train candidates for posts as Assistant ngineers in Equipment Development and Design, and as Contract Engineers.

QUALIFICATIONS

Age under 26. An industrial or similar apprenticeship in light electrical engineering preferably combined with City and Guilds final or HNC; or evidence of intention to complete similar courses up to HNC or Degree standard. Experience and aptitude in engineering drawing is necessary.

STARTING SALARIES

For Assistant Engineers in Training over 21 in the scale £13 16s. 6d. to £17 10s. 6d. to be reviewed every 6 months starting in January, 1965.

APPLY:

With full but concise details to the Staff Officer,

G.E.C. **G.E.C. (TELECOMMUNICATIONS) LTD.**

Telephone Works, Copeswood, Coventry

TESTERS

required for interesting work on L.F. and H.F. Transmitters. Previous fault-finding experience essential.

The positions available would be of special interest to persons employed in the fault-finding and repair of television who are keen to establish themselves in a position that offers:

★ Satisfactory employment
★ Five-day week
★ Good prospects of advancement
★ Staff status
★ Sick pay
★ Generous salary

Apply: Personnel Manager

Multitone Electric Co. Ltd.

12-20 Underwood St., London, N.1

SOUTH OF SCOTLAND ELECTRICITY BOARD

HUNTERSTON Nuclear Generating Station.
INSTRUMENT Mechanics are required at Hunterston Nuclear Generating Station, West Kilbride, Ayrshire, to service a wide range of physical, electro-mechanical and electronic instruments. These situations offer unrivalled opportunities for first class mechanics to widen their knowledge and gain experience on up-to-date, modern techniques. If you can service any two of the following and would like to live and work in pleasant surroundings on the Ayrshire coast, then we would like to hear from you:—

(1). Temperature, pressure and flow measuring instruments.
(2). Precision mechanisms and printers.
(3). Automatic telephone exchanges.
(4) Closed circuit television and V.H.F. radio.
(5). D.C. and pulse amplifiers.
(6). Transistor amplifiers and controllers.
(7). Transistor digital and logic circuits.

THESE posts are permanent. 42-hour, 5-day week. Hourly rate 6/7½ plus productivity allowance of 4/6 per week. On completion of two years' service an additional 8/6 per week is paid. Sick pay and superannuation schemes. Housing will be available within reasonable distance of the Generating Station to suitable applicants.
APPLICATION forms are obtainable from the Station Superintendent, Hunterston Nuclear Generating Station, West Kilbride, Ayrshire, and should be returned within four weeks of the appearance of this advertisement. [2606

L.C.C. South East London Technical College, Lewisham Way, S.E.4.
DEPARTMENT of Electrical Engineering and Applied Physics.
APPLICATIONS are invited for a post of Lecturer in Electrical Engineering. Applicants should hold a degree of a British University or equivalent qualification and/or be Corporate Members of an appropriate professional engineering institution, and should preferably have had industrial experience.
THE Department conducts part-time, sandwich and full-time courses from Ordinary National Certificate and Final City and Guilds up to full professional requirements, and covering both light current and general electrical engineering. The lecturer appointed would as far as possible be given classes commensurate with his own special interest and experience.
SALARY scale: £1,670×£45(5)—£1,895 plus London Allowance £45-£60.
APPLICATION forms obtainable from the Secretary, returnable within two weeks. [2697

ELECTRONIC Engineer required for testing transistor instruments.—Levell Electronics, Ltd., Park Rd., High Barnet. Tel. Barnet 5028. [2696

TEST engineers.—Applications are invited from test engineers with previous industrial experience of testing radio communications, receivers and transmitters; successful applicants will be offered positions on the company's permanent staff; starting salaries commensurate with qualifications and experience.—Apply in writing, giving full details to Personnel Officer, Redifon, Ltd., Broomhill Rd., S.W.18. [0252

DECCA RADAR

ELECTRO-MECHANICAL INSPECTORS
MICROWAVE INSPECTORS

The Factory and Laboratory now completed at Somerton, Cowes, for development and production of Heavy Radar Systems will require Electro-Mechanical and Microwave Inspectors. Applicants should have had experience in the manufacture of mechanical and electronic devices, able to interpret circuit diagrams and mechanical drawings, and also be familiar in the use of basic measuring instruments, micrometers, verniers, etc. Interviews can be arranged on the Mainland. Please write giving full details in confidence to: Personnel Officer, Decca Radar Limited, Somerton, COWES, I.W.

TELEVISION Operations Manager, Uganda.
APPLICATIONS are invited from candidates with a good academic background and preferably A.M.Brit.I.R.E. supported by wide and extensive experience in all aspects of the programme and operations duties of a television network including Commercial aspects. Experience in the production and direction of T.V. programmes involving the use of Telecine equipment, Vidicon Broadcast camera channels and studio operations including sound and vision mixing equipment. Sound knowledge of studio lighting equipment, camera operation, television studio floor management and the ability to train local staff employed in these duties.
THE officer appointed will be responsible to the Television Manager for day to day studio floor management, operations and traffic associated with a National T.V. Network of six or more stations supported by commercial advertising programmes.
THE appointment will be for one or two tours at candidates option with a salary in the range £2,025-£2,327 plus a Gratuity of 25%-45% of total emoluments. Free family passages. Free medical attention and furnished quarters provided at moderate rentals. Generous leave and education allowances.—Apply to Director of Recruitment, Department of Technical Co-operation, Eland House, Stag Place, Victoria, S.W.1, quoting RC 237/153/06. [2674

ELECTRONIC Technician required by Oxford University laboratory to design, construct and maintain apparatus and test-gear used for research. Experience of electronics other than radio desirable. Wages according to University scale. Apply, giving full details to Box 5281. [2684

CENTRAL AFRICAN AIRWAYS invite applications from experienced Aircraft Radio Technicians for permanent employment in Salisbury, Southern Rhodesia. Applicants are required for maintenance and overhaul of airborne radio and radar equipment. British A.R.M.E. licences are desirable.
COMMENCING salary £1,280 per annum, plus licence allowances up to £244 per annum for A & B plus radar ratings.
33 DAYS paid leave per annum, travel privileges, excellent climate, low income tax and assisted air passages to Salisbury on engagement.
APPLY to Manager, U.K. Central African Airways, Rhodesia House, 429, Strand, London, W.C.2 [2691

CARSHALTON, Surrey. Medical Research Council Laboratories (N.R.U.), Woodmansterne Road. Senior Technician with experience of construction and maintenance of electronic equipment or Junior Technician to train. M.R.C. salary scale according to age and experience, London weighting, qualifications allowance. Day release for technical study.—Applications with names of two referees to be sent to the Director as soon as possible. [2678

VACANCIES for Radio Technicians aged 19 or over at airports and radio stations throughout the United Kingdom, maintaining radio communications and electronic navigational aids. A good basic knowledge of the theory and practice of radio and/or electronics is required. The possession of recognised technical qualifications would be an advantage. Training given on equipment in use. Paid sick leave. Facilities to study for higher qualifications. Good prospects of permanent pensionable posts and promotion to Telecommunications Technical Officer. For further details apply to Ministry of Aviation, Est. 5(a)1, Room 754, The Adelphi John Adam Street, London, W.C.2. [2672

G.E.C.

COVENTRY

G.E.C. (Telecommunications) Ltd. are manufacturers of transmission systems in the VHF and micro-wave bands, and electronic and electro-mechanical telephone exchanges. We are going through a stage of considerable expansion and will be requiring the following staff from time to time over the next 12 months:—

TEST DEPARTMENT

For the junior vacancies we would like to see evidence of progress in ONC or in City and Guilds telecommunications subjects. Men who have been working on electronic or telecommunications equipment in the Services are particularly welcome. For the senior vacancies some years' experience on electronic or electro-mechanical equipment preferably combined with formal qualifications are desirable. Starting salaries are in the bracket £13/6/- to £18 a week.

CONTRACT ENGINEERS

Would be particularly attractive to men who have had wide experience of the installation and commissioning of complex telecommunications systems and who are now seeking more static employment. Starting salary not less than £1,000 a year.

INSTALLATION

Testers and installers for the installation and commissioning of transmission equipment both in the U.K. and overseas.

ELECTRONIC DESIGN ENGINEERS

Production of manufacturing drawings from laboratory schematic sketches. A formal qualification together with a mechanical as well as an electronic bent and draughting experience are required. Starting salaries are in the bracket £15-£17 a week.

Apply, with full details of age, education and experience to:—

THE STAFF OFFICER

THE GENERAL ELECTRIC CO., LTD.

Telephone Works, Copeswood, Coventry

AIR MINISTRY have vacancies for Civilian Radio Technicians at R.A.F. Sealand, Cheshire, for the servicing, repair, modification, and testing of air and ground radio and radar equipment. Commencing salary according to age is £701 to £902 p.a., max. salary £1,036 p.a. Houses may be available for renting at West Kirby some 15 miles from Sealand. —Apply to Air Ministry C.E.3h, Sentinel House, Southampton Row, W.C.1, or to any Employment Exchange. [2673

THE LONDON HOSPITAL, Whitechapel, E.1, requires a young man to assist with maintenance and construction of electronic apparatus in the department of Electroencephalography. Previous experience in this field is not necessary, but familiarity with electronic technique is essential. Starting salary according to age and experience, scale £365-£670 p.a. Continued study is encouraged and facilities will be provided for this.—Applications, with names of two referees, to the House Governor as soon as possible. [2675

SENIOR Engineers, Radio/Electronic Engineers with H.N.C., B.Sc., or equivalent, required to take overall charge of contracts abroad involving technical administration, customer liaison, and financial control of a number of radio transmitting stations. Candidates should be single, in the age group of 28 to 35, medically fit, of British nationality, and prepared to spend up to 18 months overseas accepting considerable personal responsibility. Some experience of supervision of technical staff together with a knowledge of H.F. radio transmitters is desirable.—Box 5282. [2699

SITUATIONS WANTED

EXPERIENCED Technician Engineer requires responsible position, experienced TV, radio, radar, tape recorder, also managerial experience.—Box 5278. [2680

BOOKS, INSTRUCTIONS, ETC.

W.W. '50-'53, '56-'58, complete; many odd issues for sale; offers.—Box 5284. [2700

WEBB'S log book for recording signals heard and worked, 112 pages, 9¾×8in, approved format, semi-stiff covers, excellent value 6/- post free, or callers 5/4.—Webb's Radio, 14, Soho St., London, W.1. [0021

RECEIVERS AND AMPLIFIERS—SURPLUS AND SECONDHAND

H1G Rx's, etc., AR88, CR100, BRT400 G209, S640 etc., etc., in stock.—R. T. & I. Electronics, Ltd., Ashville Old Hall, Ashville Rd. London, E.11. Ley. 4986. [0053

NEW COMPONENTS

CRYSTAL ovens, 4½in×2in×3in, 80 deg C, with 42 Terminal Posts. 47/6 each.—Rayner, 13, Mowbray St., Sheffield, 3. [2689

W. H. SMITH & CO. ELEC. ENGRS. LTD.

ELECTRONIC SERVICE DIVISION

68 Grosvenor St., Manchester 1

require additional

SERVICE ENGINEERS

in following fields

MARINE
Radar, Radio, Echo Sounders, Gyro Compasses and Pilots.

INDUSTRIAL
Instrumentation and Control, Automation, Closed Circuit T.V., Data Processing.

Vacancies exist in London, Liverpool, Southampton, Bristol, Midlands, Newcastle, Glasgow, Manchester.

A senior position exists in Liverpool for an engineer in charge. Applicants must be experienced engineers capable of supervising area work and improving depot turnover.

All applications to the above address. Preliminary interviews can be granted locally.

Ex Royal Naval C.P.O., R.E.A.s welcome.

"W.W." audio sig. gen., scope, stereo balancer, s.a.e. for itemised price list. Mullard transistor amp. capacitors in stock.—Ajax Electronics, 572, Fulham Rd., London, S.W.6. [2613

BARGAIN. Brand new loudspeakers and transformers, loudspeakers 7in×3½in. 35Ω. 12/6 each, converted transformers 235V 6.3V **0.5A**, 8/6 each; p. and p. 2/6 extra.—Tel. or write Sta. 5154. Tremere Radio Electronics, 24, Lordship Park, N.16. [2694

DIRECT TV REPLACEMENTS, Ltd., largest stockists of TV components in the U.K.; line output transformers, frame output transformers, deflector coils for most makes, official sole suppliers for many set makers, same day despatch service, day and night telephone Gip. 6166.—126, Hamilton Rd., S.E.27. [2273

LINE O.P. transformers and scan coils for most makes, exact replacements, from 25/- used and 50/- new; send s.a.e. for imm. quote, add 3/6 for p. & p.; telephone orders sent same day c.o.d.; examples; new LOPT's; Ekco T231/221, 65/-; Pye VT4/7, 59/6; Murphy V250/280, 65/-; Cossor 938, etc., 62/6; Ferguson 992-8, 69/6; Masteradio, 65/-; H.M.V. 1840-8, 65/-; Alba T321-4, etc., 52/6 used and 14/17 T/V's, callers only, £1 each.—T.C.S., Ltd., 112, Camberwell Rd., S.E.5. Tel. Rodney 7917. Open all day Saturday. [0334

NEW TEST EQUIPMENT

HEATHKITS can now be seen in London and purchased on easy terms; free brochure.—Direct TV Replacements, Ltd., Dept. W.W. 27/1, 126, Hamilton Rd., London, S.E.27. Gip. 6166. [2307

TEST EQUIPMENT—SURPLUS AND SECONDHAND

SOLARTRON oscilloscopes available, recent models in excellent condition, single and double beam; s.a.e. for list.—Box 5285. [2702

SIGNAL generators, oscilloscopes, output meters, wave voltmeters, frequency meters, multi-range meters, etc., etc., in stock.—R. T. & I. Electronics, Ltd., Ashville Old Hall, Ashville Rd., London, E.11. Ley. 4986. [0058

EXPANSION IN NAVAL RESEARCH

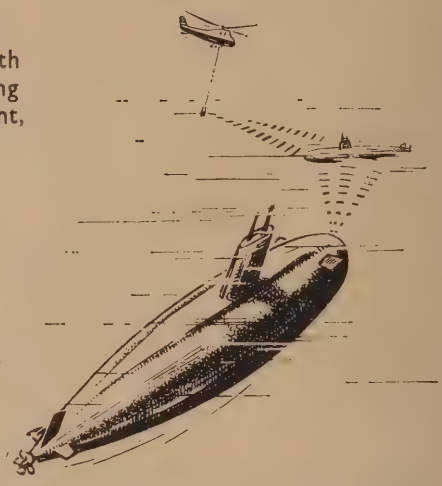
Civilian Scientists, Mathematicians and Technologists with experience in Electronics. Acoustics or Data processing required at Admiralty Underwater Weapon Establishment, Portland, for:—

NEW SUBMARINE DETECTION SYSTEMS AND ALLIED INVESTIGATIONS.

Senior Scientific Officers. £1,438 to £1,772 p.a.

Scientific Officers. £791 to £1,309 p.a. plus £95 p.a. addition after 2 years' p.g. experience.
(1st or 2nd Class Honours Degree or equivalent essential).

Experimental Officers. £1,164 to £1,431 p.a.
(H.N.C. minimum qualification).



Write to:—

Superintendent, Scientific Personnel, **ROYAL NAVAL SCIENTIFIC SERVICE**
Admiralty, Empress State Building, London, S.W.6.

NEW GRAM AND SOUND EQUIPMENT

TAPE recorders and decks by Ferrograph, Brenell, Truvox, Vortexion, Telefunken.
TUNERS and amplifiers by Quad, Leak, Rogers, Chapman.
MICROPHONES and stands by AKG, Reslo, STC, etc.
THE fabulous Microkit condenser, mic. highest professional performance, kit 20gns; complete ready to use, 25gns.
ALL tapes and accessories.
RAPID postal service anywhere in world; good quality part exchanges welcome; h.p. facilities; specialist audio service dept., records, all labels —Parastat service.
LAMBDA RECORD Co., 95, Liverpool Rd., Liverpool, 23. Tel. Great Crosby 4012. [2396

GLASGOW.—Recorders bought, sold, exchanged; cameras, etc., exchanged for recorders or vice-versa.—Victor Morris, 343, Argyle St., Glasgow, C.2. [0201

JOIN Audio Supply Association and save on cost of hi-fi. 7/6 p.a., 60-page photographically illustrated (non advert.) hi-fi catalogue, 4/6.—10, Clifford St., London, W.1. [0132

RETURN of post service; record changers, players and tape decks, some at special prices; speakers, Martin tape kits, Mullard amplifier kits, Jason tuners, test meters, all in stock, H.P. available; send for free illustrated lists, postal only.—Watts Radio, Ltd., 54 Church St., Weybridge, Surrey. Tel. 47556. [0077

"EROICA" RECORDING STUDIOS (Est. 1949) for quality in sound recording. The following have had slight use in our studio and are perfect: one Ferrograph 420 (series 5) stereo recorder, at £90 (save £25/10); one Ferrograph YDBH 15/7½, 3 heads, steel case, £85 (save £35); one Truvox PD 8 5 quarter track tape unit, £45; also new equipment for language training, research, etc.; tape/disk service.—"Eroica" House, 34, Ashley Rd., Altrincham. Alt. 6688. Studio Director: Thurlow Smith, A.R.M.C.M. [0122

TAPE RECORDING, ETC.

FERROGRAPH 5/AN, under one yr., £72, no offers (London).—Box 5247. [0140

"SLEEP learning," the book essential for all go-ahead people.—Send 6/6 to York House Huddersfield. [0187

SAVE on cost of hi-fi. See Audio Supply notice (advert No. 0132) under "New Gramophone & Sound Equipment" column. [0140

A UNIQUE buy! Recording tape top brand, 5¼in 1,200ft 19/6; 7in 2,400ft D.P. 28/6; p. and p. 1/6 per spool; bargains in all sizes, s.a.e. for list
E. C. KINGSLEY & Co., 132, Tottenham Court Road, London, W1. Euston 6500. [0272

TAPE/DISC/TAPE transfer editing; duplicating; if quality and durability matter (especially with LPs from your precious tapes) consult Britain's oldest transfer service.—Records published for fund raising (Tax Free). Sound News Productions 10, Clifford St., London, W.1. Reg. 2745. [0192

VALVES

VALVE cartons by return at keen prices; send 1/- for all samples and list.—J. & A., Boxmakers, 75a, Godwin St., Bradford, 1. [0172

VALVES WANTED

WE buy valves for cash, large or small quantities, old types or the latest; send details, quotations by return.—Waltons Wireless Stores, 15, Church St., Wolverhampton. [0102

ALL types of valves British or American, transmitting and receiving; keenest cash prices paid. What have you got to offer?—Write or call Lowe Bros., 95-97, Redchurch St., London E.2. Tel. Shoreditch 4415-6. [2382

WANTED EXCHANGES

A PROMPT cash offer for your surplus brand-new valves and transistors.—R.H.S., Beverley House, Manville Terrace, Bradford, 7. [0191

WANTED, all types of communications receivers and test equipment.—Details to R. T. & I. Electronics, Ltd., Ashville Old Hall, Ashville Rd., London, E.11. Ley. 4986. [0163

URGENTLY wanted, manuals or instruction books, data, etc., on American or British Army, Navy or Air Force radio and electrical equipment.—Harris, 93, Wardour St., W.1. Gerrard 2504. [2271

REPAIRS AND SERVICE

SPEAKER repairs, cones fitted, guaranteed satisfaction.—L.S. Repair Services, Pluckley, Ashford, Kent. [0223

TV tuners, all makes, completely overhauled, 90 days' guarantee; state model and complaint for prompt service.—Tuner Service, Clay Hill, Beenham, Nr. Reading, Berks. [2687

WE specialise in tape recorder and Hi Fi repairs and offer a speedy service.—Telesonic, Ltd., 92, Tottenham Court Rd., W.1. Mus. 8177 Leading Hi Fi Dealers. [0044

BOULTONS OF BRADFORD, loudspeaker and pressure unit repairs, D.C.B. cone assemblies in cartons, satisfaction guaranteed.—D. C. Boulton, 134, Thornton Rd., Bradford, 1. Tel. 22838. [0171

MISCELLANEOUS

METALWORK, all types cabinets, chassis, racks, etc., to your own specification, capacity available for small milling and capstan work up to 1in bar.
PHILPOTT'S METAL WORKS, Ltd., Chapman St., Loughborough. [0208

COSSOR 1049 double beam oscilloscope, £32; new precision signal generators 445/485 kc/s, crystal check, optional modulation carrier level meter, £8.
CLASS "D" wave meters with instructions, phones, spares, £5.
CLASS "D" Mk. II mains-operated wave meter/signal generator, new with spares; £10.
MARCONI twin pen high-speed recorder type UG8; £20.
STABILISED power unit, mains input, 250/400v 150 M/A output; £5.
STABILISED power unit, 115v input, 18/36v 20 amp. output, metered; £20. G3LMR.—112, Groby Rd., Glenfield, Leicester. [2683

BENSON'S better bargains, send s.a.e. for free catalogue of Government and manufacturers' electronic surplus, to—Superadio (W.), Ltd., 116, Whitechapel, Liverpool, 1. [2564

SERVICE sheets, radio, television, tape recorders and various valves for sale, s.a.e., state requirements.—She, 8441, John Gilbert Television, 1b, Shepherd's Bush Rd., London, W.6. [2563

GOVERNMENT COMMUNICATIONS HEADQUARTERS
requires
RESEARCH AND DEVELOPMENT CRAFTSMEN

RADIO MECHANICS for the maintenance and installation of radio communication receivers and equipment.

TELEPRINTER MECHANICS for the maintenance of teleprinter and cypher machines and associated telegraph equipment.

COMPUTER MECHANICS for the maintenance of computer peripheral equipment including magnetic tape handlers, paper tape equipment and electric typewriters.

WIREMEN for prototype sub-assembly layout, wiring and testing of radio and computer type chassis.

BASIC PAY £11/12/- per week plus supplementary pay up to **87/-** per week. Supplementary pay will be assessed at interview based on ability and the necessary basic qualifications.

Apply in writing to:
Recruitment Officer (RDC/3), G.C.H.Q. "A" Block, Oakley Priors Road, Cheltenham, Glos.

RELAYS, mains voltage for sale a.c. miniature 5amp 3 contact making one breaking printed circuit connection or may be soldered; surplus stock of several thousands for disposal.—Tel. Mr. Morris, Sunbury-on-Thames 5500. [2698

CATALOGUE No. 15, government surplus electrical and radio equipment, hundreds of items at bargain prices for the experimenter and research engineer; 2/6 post free, catalogue cost refunded on purchase of 50/-.—Arthur Sallis Radio Control, Ltd., 93, North Rd., Brighton. [0195

NOTICES

THE ASSOCIATION OF PROFESSIONAL RECORDING STUDIOS, Ltd. To protect and encourage the interests of member studios engaged in electrical sound recording.—Write to the General Secretary, A.P.R.S., Flat 4, 34A, Arterberry Rd., London, S.W.20. [0173

BUSINESS AND PROPERTY

WELL-ESTABLISHED electronic manufacturing company for sale, fully equipped factory, 2,000 sq ft, including machine shop; long lease, low rental; London area; £4,000.—Box 5283. [2701

BUSINESS OPPORTUNITIES

IF you are a self-employed TV service engineer wishing to increase your profits by at least 25% and receive free technical information, send s.a.e. for details to Box 5273. [0033

CAPACITY AVAILABLE

RECTIFIERS, Selenium and Silicon units supplied for all applications, keen prices, good deliveries.
J. R. SERVICES & DEVELOPMENTS, 231, Rivermill, Harlow, Essex. Tel. Harlow 26481 [2599

WE undertake the manufacture of transformers singly or in quantities to any specification all work guaranteed for 12 months.
LADBROKE TRANSFORMER Co., Ltd., 820a, Harrow Rd., London, N.W.10. Tel. Ladbroke 0914. [0220

AIRTRONICS, Ltd., for coil winding assembly and wiring of electronic equipment Transistorised sub-units.—4, Ashmead Rd., London S.E.8. Tel. Tideway 2249. [2670

HUDDERSFIELD COLLEGE OF TECHNOLOGY
DEPARTMENT OF ELECTRICAL ENGINEERING

COLOUR AND 625 - LINE T.V. SERVICING
will be included in the symposium on
INDUSTRIAL ELECTRONICS
2nd and 3rd April

The latest ancillary servicing equipment will be displayed.
Further details from the Department.

H. GRAY
Clerk to the Governors.

UNITED KINGDOM ATOMIC ENERGY AUTHORITY
WINDSCALE AND CALDER WORKS

INSTRUMENT MECHANICS

Windscale and Calder Works require experienced men with knowledge of electronic equipment and/or industrial instrumentation for fault diagnosis, repair and calibration of a wide range of instruments used in nuclear reactors, radiation laboratories and chemical plant. This work involves the maintenance of instruments using pulse techniques, wide band low noise amplifiers, pulse amplitudes analysers, counting circuits, television and industrial instruments used for the measurement of pressure, temperature and flow.

Men with at least five year Services, Industrial or Commercial background of radar, radio, television, industrial or aircraft instruments are invited to write for further information. Training Courses in Specialised Techniques are provided for successful applicants having suitable instrumentation background.

Rate of pay £14/5/- rising to £15 per week.

Married men living beyond daily travelling distance will be eligible for housing. A lodging allowance is payable whilst waiting for housing.

Write for details, quoting reference BP.195 to:—
Works Labour Manager, U.K.A.E.A.,
Windscale and Calder Works, Sellafield, Seascale. Cumberland.

PEGASUS COMPUTER ENGINEER

Digital computing facilities are provided by the Operational Research Department of BISRA for the benefit of other sections of BISRA and for member steel companies, in addition to the extensive use made of these facilities by the department itself in carrying out its own work.
Applications are invited for the post of Maintenance Engineer for the Pegasus computer installation at BISRA'S Battersea Laboratories. Although the basic responsibility of the maintenance engineer is to maintain the computer in good working order, the opportunity does arise to design and construct additional electronic devices.
Suitable applicants will have had some experience in maintaining digital computers or similar electronic equipment and will possess an Ordinary National Certificate or a qualification of an equivalent standard. Training facilities in Pegasus computer maintenance will be provided, if necessary, for an otherwise suitably qualified engineer.
Applications stating age, qualifications and experience should be sent to:—

BISRA

THE PERSONNEL OFFICER, BRITISH IRON & STEEL RESEARCH ASSOCIATION,
24, Buckingham Gate, London, S.W.1.

SENIOR DEVELOPMENT ENGINEER

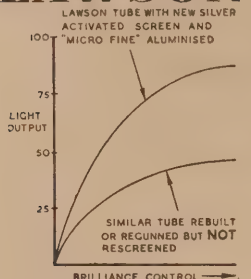
An opportunity arises for a qualified engineer to fill an interesting and progressive position in the Special Products and Electronics Division of a large engineering group. He would be responsible for the development of basic systems, including high-intensity ultrasonic equipment and specialized industrial products.
Engineers with graduate or equivalent qualifications and several years' experience of development work, particularly on basic circuit design, are invited to apply for this appointment with the vigorous and rapidly advancing Kerry Group.

Write briefly in the first instance, stating age qualifications and experience, to
Mr P G Day, B.Sc. Technical Director

P. G. Day (Electronics) LTD.
Wilbury Way,
Hitchin,
Hertfordshire

A Kerry Group Company

LAWSON



EXTRA PASSENGER TRAIN SERVICE
Our service is country wide and whether you live in the Outer Hebrides or at No. 10 we can guarantee the finest and fastest CRT service in Great Britain.

Full fitting instructions with every tube.

LAWSON TUBES
2, PEACHFIELD CLOSE, MALVERN WELLS, WORCS.
TEL.: 2100

DIRECT REPLACEMENT TELEVISION TUBES

12 MONTHS *FULL REPLACEMENT* GUARANTEE

DESIGNED FOR PERFORMANCE

The modern Lawson Television tubes are specially designed to give the older types of television set very much improved performance. Their new silver activated screens are much brighter with better contrast, exclusive "micro fine" controlled thickness aluminising gives 50 per cent. more light output. New small anode aperture electron guns by Mullard, Mazda, G.E.C., Brimar, E.E., Cossor, etc., with crisp needle-sharp definition and focus. Silicon vacuum pumping plus depth formed cathodes giving very long life. Each tube is 100 per cent. **BRAND NEW** (glass excepted) and is designed to fit exactly as the original tube, ensuring complete accuracy and efficiency.

FROM STOCKS OF OVER 5,000 TUBES OF EVERY MAKE AND TYPE, WE CAN SUPPLY THE *EXACT* TUBE YOU REQUIRE BY RETURN.

12"—£4 : 10 : 0
14"—£5 : 5 : 0
15"/17"—£5 : 15 : 0
21"—£7 : 10 : 0
CARR. & INS. 7/6

Terms C.O.D. or C.W.O. *DELIVERED FREE*
LONDON POSTAL DISTRICTS **10/-** Gladly refunded if you wish to return your old tube (excluding 12in.).

5WW—174 FOR FURTHER DETAILS.

100% TRANSISTORS

OC44, OC45, OC81, OC81D, 3/6 each. OC170, AF117, OC171, 4/- each. OC26, OC35, 10/- each. XB103, XA102, XA112, 2/- each. RED AND WHITE SPOTS 1/- each. XC141 6/- each. 250M ZENERS, 3/6 each. 4 v. to 22 v. *S.A.E. LIST.*

B. W. CURSONS
78 BROAD STREET, CANTERBURY

5WW—180 FOR FURTHER DETAILS.

5WW—175 FOR FURTHER DETAILS.

SERVICES OFFERED

LEAVE it to us.

FOR all electronic wiring, small or large, metal fabrication, engraving, etc., highly competitive prices and excellent delivery.
APPLY: Contracts Manager, C. & B. Electronics, Ltd., 3, Wellington Road, St. Mary Cray, Orpington, Kent. Tel. Orpington 22600. [2488

PRINTED circuit service; small quantity runs quickly and economical.—Quotations and information from Teleradio Co., Ltd., 18, Turnpike Lane, N.8. [2638

INDUSTRIAL Electronic Control, a small company specialising in the above has capacity for sub-contracts involving design, manufacture or maintenance.—Saunders Electronic Mfg. Co., Ltd., 10, Cash's Lane, Coventry. Tel. Coventry 28631. [0026

TECHNICAL TRAINING

P.M.G. Certificates, City & Guilds examinations, Brit.I.R.E., also many non-examination courses, with radio, TV and electronics; study at home with world-famous I.C.S.—Write for free prospectus, stating subject, to International Correspondence Schools (Dept. 443), Intertext House, Parkgate Rd., London, S.W.11. [0029

CITY & GUILDS (electrical, etc.), on "No Pass—No Fee" terms, over 95% successes. —For details of modern courses in all branches of electrical engineering, applied electronics, automation, etc., send for 148-page Handbook—free and post free.—B.I.E.T. (Dept. 388A), 29, Wright's Lane, London, W.8. [0017

HAVING TROUBLE

with Hi-Fi, R/Control, Radio Kits or T/V? Send your equipment or describe problem (with circuits) to

D. A. TILLEY
Qualified R.T.E.B. Technician
27 **STOUGHTON ST., LEICESTER**
MODERATE CHARGES

5WW—176 FOR FURTHER DETAILS.

Since 1941 we have
HAND BUILT HIGH FIDELITY EQUIPMENT

V.H.F. tuners from £15. Multi waveband tuners including or less V.H.F. band from £22. Tone control units, Mono and Stereo amplifiers, etc. Technical details willingly.

ELECTRO Acoustic DEVELOPMENTS
2 AMHURST ROAD
TELSCOMBE CLIFFS
NEWHAVEN
SUSSEX

5WW—178 FOR FURTHER DETAILS.

"WIRELESS WORLD" TEST INSTRUMENTS

Complete sets of Metalwork, machine engraved Fronts Panels, Special Tag Boards and all specified 1st grade components.
For Professional appearance and performance.
Send 6d. in stamps for lists.
MALVYN ENGINEERING WORKS
Engineers to the Radio and Electronic Industries
7 CURRIE STREET, HERTFORD, HERTS
TELEPHONE · HERTFORD 2264

5WW—181 FOR FURTHER DETAILS.

WORLD RADIO & T.V. HANDBOOK 1964 ED. 22/-

By JOHANSEN. Postage 1/-.

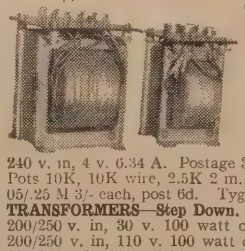
Amateur Radio Call Book, 1964, by R.S.G.B. Postage 6d. 4/6
Introduction to Lasers and Masers, by Lytel. Postage 1/-..... 16/-
Radio and Line Transmission, Vol. 1, by Danielson.—Vol. 2, **22/6**. Postage 1/-..... 21/-
Understanding Amateur Radio, new ed., by A.R.R.L. Postage 1/-..... 19/-
Frequency Divider Organs for the Constructor, by Douglas. Postage 1/- 25/-
Transistor Inverters and Converters, by Roddam. Postage 1/-..... 42/-
Transistor T.V. Receivers, by Towers. Postage 1/3..... 55/-
British Transistor Directory, by Bradley. Postage 9d..... 8/6
Special offer of British Micro Alloy Transistors. Send for list.

UNIVERSAL BOOK CO
12 LITTLE NEWPORT STREET, LONDON, W.C.2.
(adjoining Lisle Street)

5WW—177 FOR FURTHER DETAILS.

HARRINGAY SUPPLIES

345 HORNSEY ROAD, N.19 *ARC 4107*
SMALL MODEL MAKERS' MOTORS
24 v. A.C./D.C. Reduction geared, new. Size 1¼in. × 1in. × 2¾in. long **12/6** each. P/p. 1/6. Othert ypes of small 12 or 24 v. motors in stock.



TRANSFORMERS 210/250 v. in. 275–0–275 v. 50 mA. 6.3 CT. 3 A. out, **17/6.** 210/259in, 300–0–300 v. 125 mA. 6.3 CT. 2A, 6.3 CT. 2.5 A., 5 v. 2 A. out, **22/6.** 220 240 v. in, 4 v. 6.34 A. Postage 3/- in the £1 on all Pots 10K, 10K wire, 2.5K 2 m., 25K Lin and Log 05/.25 M 3/- each, post 6d. Tygan Fret **2/-** sq. ft.
TRANSFORMERS—Step Down.
200/250 v. in, 30 v. 100 watt out **17/3**, post 2/-. 200/250 v. in, 110 v. 100 watt out **17/6**, post 2/-. 200/250 v. in, 110 v. 3.04 amps out **24/10/-**. post 5/-.
ARDENTE LIGHTWEIGHT EARPHONES with rubber moulded lead and jack plug, **40/-.**
EX BCC GRAM UNITS 78 R.P.M. with amplifier and speaker, **£6/10/-** each, carr. 5/-.
HELIOGRAPH SIGNALLING MIRRORS complete with spare mirror, accessories are in fitted leather case, new 12/6 each. Carr. 4/6.
1,200ft. TAPE SPOOLS 2/6 each, post 1/-.
6in. P.M. HEAVY DUTY SPEAKERS in steel double grilled wall mounting cabinet, new **30/-**, p/p. 4/-.
24 v. 20 AMP SELENIUM RECTIFIERS heavy duty **30/-** s/h., p/p. 3/6.

5WW—179 FOR FURTHER DETAILS.

NYLON · P.T.F.E.

ROD, BAR, SHEET, TUBE, STRIP, WIRE
No quantity too small. List on application.
BRASS · COPPER · BRONZE
ALUMINIUM · LIGHT ALLOYS
STAINLESS STEEL
H. ROLLET & Co. Ltd.
Howie Street, S.W.11. *BATtersea 7872*
ALSO AT LIVERPOOL BIRMINGHAM MANCHESTER. LEEDS GLASGOW

5WW—182 FOR FURTHER DETAILS.

240 volt ELECTRIC POWER ANYWHERE
ANYTIME from 12 volt CAR BATTERY
with the **AMERICAN DYNAMOTOR UNIT**

Input 12v. output 200/250v. at 150 to 220 watts. Perfect for TELEVISION, POWER TOOLS and all universal AC/DC ELECTRICAL EQUIPMENT, gives wonderful results. Price ONLY £8 + 12/- carriage. Send stamped envelope for full illustrated details
L. SCIENTIFIC PRODUCTS, CLEVELEYS, Lancs.

5WW—183 FOR FURTHER DETAILS.

CABINETS AT SENSIBLE PRICES FROM £5 . 7 . 6d!

You can be sure of meeting the exact cabinet you require when you examine the most extensive range in the country at Lewis Radio, here are just two examples:

THE BRAHMS
Price 26 gns.

This new elegant Brahms cabinet is available in medium walnut and medium mahogany or teak with 9in. legs and will take any tape deck, turntable, tuner and pre-amplifier, the largest stereo amplifier plus record and tape storage

THE LOWBOY
Price 24 gns.

This rigidly constructed Hi-Fi cabinet will accommodate even the largest Hi-Fi units—available in teak, walnut or stripcy sapele mahogany—size 53in. long by 20¾in. deep by 26in. high including 12in. legs.

FREE: THE NEW LEWIS CATALOGUE

Designed to assist your choice of cabinet.

THE new Lewis Radio Cabinet Catalogue—the most comprehensive ever prepared. Sent absolutely Free.

Please send your new cabinet catalogue.

NAME AND ADDRESS

.....

.....

..... (Dept. 264)

CAPITALS PLEASE

LEWIS radio

100 CHASE SIDE, SOUTHGATE, LONDON, N.14
Telephone: Palmers Green 3733/9666
5WW—184 FOR FURTHER DETAILS.

LEARN Radio and Electronics the New Practical Way! Very latest system of experimenting with and building radio apparatus.—"as you learn."—Free brochure from Dept. W.W.10. Radiostructor, Reading. [0241

RADIO and TV exams and courses by Britain's finest home study school; coaching for Brit.I.R.E., City & Guilds, Amateurs Licence, R.T.E.B., P.M.G. Cert., etc.; free brochure from—British National Radio School, Russell St., Reading. [0189

TUITION

FULL-TIME courses for P.M.G. certificates and the radar maintenance certificate, also in electrical and electronic engineering.—Information from College of Technology, Hull. [0114

FIND TV set trouble in minutes from that great book The Principles of T.V. Receiver Servicing, 10s. 6d. all book houses and radio wholesalers.—If not in stock, from Dept. A, Secretary, 32, Kidmore Rd., Caversham, Reading, Berks. [0089

THE Incorporated Practitioners in Radio & Electronics (I.P.R.E.), Ltd., Membership Conditions booklet 1/-; sample copy of I.P.R.E. official Journal 2/- post free.—Dept. A, Secretary, 32, Kidmore Rd., Caversham, Reading, Berks. [0088

RADIO officers, see the world; sea-going and shore appointments; our many recent successes provide additional trainee vacancies during 1964; day and boarding students; grants and scholarships available; stamp for prospectus.—Wireless College, Colwyn Bay. [0031

STUDY radio, television and electronics with the world's largest home study organisation; Brit.I.R.E.; City & Guilds; R.I.E.B., etc., also practical courses with equipment; all books supplied.—Write for free prospectus, stating subject, to I.C.S. (Dept. 442), Intertext House, Parkgate Rd., London, S.W.1. [0032

BECOME "Technically Qualified" in your spare time, guaranteed diploma and exam. home-study courses in radio, TV, servicing and maintenance, R.T.E.B., City and Guilds, etc.; highly informative 120-page Guide—free!—Chambers College (Dept. 433), 148, Holborn, London, E.C.1. [0013

BRIT. I.R.E., City & Guilds and R.T.E.B. exams. Specialised ICS home-study course will ensure success. For details of wide range of exam. and diploma courses in radio, T.V. and electronics, also new practical courses with kits, write to: ICS (Dept. 522), Parkgate Road, London, S.W.11. [0036

"HOW and Why" of Radio and Electronics made easy by a new, no-maths Practical way Postal Instruction based on hosts of experiments and equipment buildings carried out at home. New Courses bring enjoyment as well knowledge of this fascinating subject.—Free brochure from Dept. W.W.122, Radiostructor, Reading. [0240

A.M.I.Mech.E., A.M.Brit.I.R.E., City & Guilds, G.C.E., etc., bring high pay and security. "No Pass—No Fee" terms; over 90% successes.—For details of exams. and courses in all branches of engineering, building, electronics, etc., write for 148-page Handbook—free.—B.I.E.T. (Dept. 387B), 29, Wright's Lane, London, W.8. [0118

TV and Radio—A.M.Brit.I.R.E., City and Guilds R.T.E.B. Cert., etc., on "No Pass—No Fee" terms, over 95% successes.—For details of exams. and home training courses (including practical apparatus) in all branches of radio, TV and electronics, write for 148 page Handbook—free.—B.I.E.T. (Dept. 397A), 29, Wright's Lane, London, W.8. [0016

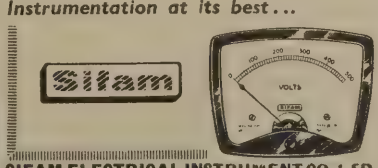
PERSONAL

8mm glamour films, bumper parcel of illustrated catalogues 2/-, complete with details of how to get a free cine projector.—Paradise Films (Dept. 118), 49, Portland Rd., London, W.11. [0078

FINANCIAL

RELEASE capital tied up in book debts by using our sales finance service.—HCM, 115, Gloucester Pl., W.1. [0196

Instrumentation at its best...



SIFAM ELECTRICAL INSTRUMENT CO. LTD.
WOODLAND ROAD, TORQUAY. Tel. 63822/3
5WW—185 FOR FURTHER DETAILS.

EXCLUSIVE OFFERS

★ American Carbon Mikes, on table stand new	10
★ American T47 Morse Keys	5
★ AN/FGC-1 Teletype Terminals	£75 0
★ Marconi "Electra" Receiver and Power Supply	£75 0
★ Marconi "Mercury" Receiver and Power Supply	£45 0
★ American Power Units, PE-237	£12 10
★ S.T.C. RX-5 Receivers	£85 0
★ T-4/FRC Transmitters	£65 0
★ MD-1/FRC Modulators	£75 0
★ Motorola Mobile Transmitters 30/40 mc/s F.M. 6 v.	£12 10
★ AN/TCC-3 Telephone Carrier Terminals	£150 0
★ Kleinschmidt 2 A. 5 unit Teleprinters	£25 0
★ TT-40/FT Teletype Terminals	£55 0
★ E.M.I. Recording Bridges, 230 v. A.C.	£12 10
★ E.H.T. Rectifier, 18 KV 500 m/a	£250 0
★ Philco C.43 Transmitters, 2/12 mc/s	£75 0
★ Western Electric Stabilised Power Supply, 115 v. 1 amp	£17 10
★ 85-foot 2½in. dia. Steel Tubular Masts	£50 0
★ 5-foot Post Office Racks, 19in. wide	£3 10
★ 15 KVA Constant Current Transformers	£75 0
★ Pen Type Personal Dosemeters	15
★ 1½ KVA Double Wound Totally Enclosed Transformers, 250/110 v.	£6 10
★ 75-foot Hollow Plywood Masts	£35 0
★ E.M.I. 3794 Waveform Monitors on trolley	£125 0
★ E.M.I. WM5A Oscilloscopes	£175 0
★ Metro-Vickers H.S.500 Waveform Monitors	£225 0
★ R.201 85-valve Triple Diversity Receivers	£75 0

40-page list of over 1,000 different items in stock available—keep one by you.

★ R.C.A. 420 mc/s. 5-element Yagi Aerial Array	£2 10
★ 19in. Folding Rack Shelves, nickel and grey	£1 10
★ S.O.S. Distress Band 500 kc/s. Precision Filters	£1 10
★ Woden 400 m/a 20 Henry Chokes	£1 5
★ Crypton Cabinet Rectifiers, 200/250 v. to 50 v. 1 a.	£3 0
★ BC-610 Whip Aerials, 3 sections, 9 feet long	£1 10
★ American Condensers, 3,500 mfd. twice 25 volts	10
★ Precision Mains Filter units	10
★ R.C.A. 25 Watt Horn Projector Speakers, range 1 mile	£15 0
★ R.C.A. Squadron Announcing Systems, capacity up to 12 speakers	£95 10
★ Dowty High Speed Register Counters, 4in.	£6 0
★ Edwards Speedivac Pumps, 230 v. A.C.	£22 10
★ Metro-Vickers Metrovac Pumps, 230 v. A.C.	£17 10
★ Avo Geiger Counters	£9 10
★ DAE-1 Marine Receivers	£22 10
★ PV-500 watt Marconi Transmitter, 3/19 mc/s	£200 0
★ E.C.C. 10 KW Rectifiers, 230 v. A.C. to 220 v. 47 a.	£75 0
★ TCC-3 Carrier Telephone Systems	£205 0
★ RD-115 Twin Channel Video Type Tape Recorders	£125 0
★ Type 44—5-unit Keyboard Perforators	£12 10
★ Creed Morse to 5-unit Electronic Converters	£95 0
★ Teletype Metal Tables for 2 machines	£4 10
★ Eddystone S.750 Receivers	£42 10

Carriage extra at cost on all above.

We have a large quantity of "bits and pieces" we cannot list—please send us your requirements—we can probably help—all enquiries answered.

P. HARRIS
ORGANFORD - DORSET
WESTBOURNE 65051
5WW—186 FOR FURTHER DETAILS.

LONDON CENTRAL RADIO STORES

MAGNETO TWIN BELLS. 2½in. gongs, 50 volts D.C. New and boxed. **14/6.**
HEADPHONES. DLR3, with metal band and rubber velvet earpads, lead and plug, **10/-.**
ELECTRICITY SLOT METERS. (1/- in slot) for A.C. mains. Fixed tariff to your requirements. Suitable for hotels, etc. 200/250 v. 10 A. **84/-**; 15 A. **94/-**; 20 A. **104/-**; other amperages available. Reconditioned as new. 2 years' guarantee.
QUARTERLY ELECTRIC CHECK METERS. Reconditioned as new. 200/250 v. 10 A. **42/6**; 15 A. **52/6**; 20 A. **57/6.** Other amperages available. 2 years' guarantee.
SUPERIOR TYPE DESK PHONES, black Bakelite cases. Complete with Hand Set. Dial 0-9 and internal bell. **£3/7/6.**
20-WAY PRESS-BUTTON INTER-COM. TELEPHONES in Bakelite case with junction box. Thoroughly overhauled. Guaranteed. **£7/15/-.**
10-WAY PRESS-BUTTON INTER-COM. TELEPHONES in Bakelite case with junction box. Thoroughly overhauled. Guaranteed. **£6/15/-.**
5-WAY PRESS-BUTTON INTER-COM. TELEPHONES in Bakelite case with junction box. Thoroughly overhauled and guaranteed. **£4/12/6.**
INDICATOR LAMPS. 10 in each strip, approx. size 11×3¼in. **15/-.**
BRASS JACK STRIPS. 10 Jack sockets in each strip. Size approx. 11×3¼in. **12/6.**
8-BANK UNISELECTOR SWITCHES. 25 contacts, alternate wiping **£2/15/-.** 8 bank half wipe **£2/15/-.** 6 bank, half wipe, 25 contacts, **47/6.**
ALL GAUGES INSTRUMENT WIRE. Tin copper enamelled cotton silk resistance wires from 16 S.W.G. to 50 S.W.G. List sent on request. Send S.A.E.
HIGH-SPEED ELECTRO-MAGNETIC COUNTERS. Ex-Govt. 0-9,999, 25/50 v. D.C. Size 4×1×1in. Single coil 2,300Ω. Single coil 500Ω. **15/-.**
HEAVY DUTY HAND GENERATORS, with handles. **14/6.**
CHROME TELEPHONE DIALS. 0-9. Suitable for inter-office and factory installation. **12/6.**
G.P.O. TELEPHONE TYPE CARBON HANDSETS 10/6.
5in. ROUND MOVING COIL SPEAKER. 3 ohm. **10/6**; 10in. **22/6.** 8in. 3 ohm **10/6.**
Elliptical Speakers. 7×4in. **10/6.**

All prices include carriage in United Kingdom

23 LISLE ST. (GER. 2969) LONDON, W.C.2
Closed Thursday 1 p.m. Open all day Saturday

5WW—187 FOR FURTHER DETAILS.

TAKE YOUR PICK 2/6 ANY PACK FOR
NEW COMPONENTS

30 Carbon Resistors, asstd	15 Ceramic Condensers.
35 Springs Tension, asstd.	27 Condenser Clips, etc.
12 Knobs, Radio and TV	75 Felt Washers & Strips.
24 Clamps and Brackets.	10 Fuse Holders, assorted.
15 Assorted Tag-Strips.	40 Mounted Tags, asstd.
6 Equipment Handles, etc.	12 Equipment Feet, Bro.
10 Valve Holders, asstd.	250 Sleeves and Grommets.
16 Socket Panels, asstd.	10 Plugs assorted.
15 Coil Formers, asstd.	6 TV-type Coils.
3 Radio-type Coils.	6 Sub-min. Trimmers.
8 Stamp-type Trimmers.	45 Cable Clips, etc.
6 R.F. Chokes, asstd.	24 Loudspeaker Gauzes.
3 Potentiometers, asstd.	15 Push-Button Knobs.
8 Wafer Switch Biscuits.	2 Wafer-type Switches.
3 Add-on DP Switches	1 Slider-type Switch.
3 Dropper Resistors.	6 Motor Car Bulbs.
16 Valve Top Caps, chrome.	12 Anti-vibration Mounts.
60ft. Sleeving, assorted.	500 sq. in. Aluminium scrn.
340 sq. in. Rexine Cloth, twn	350 sq. in. Insulating Board.
12 Paper Tube Condensers.	60 Nuts, Bolts & Washers.
72 Self-tap screws, asstd.	72 End Terminal Covers.
12 Mica Condensers, asstd.	3 Electrolytic Condensers.
1 Gram Mounting Kit.	3 Printed Circuits.
4 HD Carbon Brushes.	3 Block Paper Condenser.
10 Diodes (rejects).	1 Turret Tuner Chassis.
7 Metalpack Condensers.	1 Rectifier half-wave.
1 Twist Drill Set.	1 Twin Ion Trap assembly.
6 Valve Screening Cans.	24 sq. in. Felt Tape.
45ft. Prestic Compound.	33 Impedance Match Panels
3 2a. 2-pin s/w Sockets.	10 SES Lampholders.

All the above packs are assortments taken from our normal catalogued stocks, below normal catalogue prices. These Pre-Packs have been made up in response to popular request.

EQUIPMENT (Mint Condition)

PULSE GENERATOR No. 2. 230 v. A.C. self-contained P.U. (Ideal 75 watt Amplifier), 550-0-550 v., etc. Trans., 4 × 807's. £16
MODULATOR UNIT No. 28. Similar unit, contains 12 valves, 345-0-345 v., etc. Trans. (Convert. to TX or Amp., etc.) £11
PULSE GENERATOR No. 19. Similar unit, but smaller, 230 v. 1P, 300-0-300 v., etc. Trans.. All Units have Grey cases £8
TEST SET MICROPHONE AND RECEIVER No. 4, complete £27

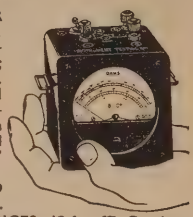
MISCELLANEOUS BARGAINS

Pocket Voltmeters 0-15 v. and 0-250 v. 9/6. 4-Valve Modulator Units 11/6. AC/DC Power Units 11/-. No. 19 Control Units 5/-. 7 TV Pots Mounted 7/6. Dimmer Switches 7/6.

ALBATROSS ENGINEERING COMPANY
DEPT. WWIA 78-80 HIGH ST. GOSBERTON. SPALDING LINCS.

5WW—188 FOR FURTHER DETAILS.

SOUTHERN RADIO'S WIRELESS BARGAINS



TEST METERS, FOR TABLE, 3¾ × 3¾ × 2½in. D/C M/C. Ranges: 0-5,000 ohms; 0-60 mA; 0-3 volts; 0-1.5 volts. Range can be extended to suit individual requirements by addition of resistances. (Featured in "Practical Wireless,' March 1961 issue.)
NEW AND TESTED 12/6 each plus 2/- P. & P.
SPECIAL QUANTITY PRICES: 12 for **£7.** Carriage paid U.K. (ex sea routes).
METERS. 30–0–30 and 3–0–3 volts combined ranges with prods., **15/-.**
ATTACHMENTS for "38" TRANSMITTER-RECEIVERS Mark II. HEADPHONES **15/6** per pair; THROAT MICROPHONES **4/6**; JUNCTION BOXES **2/6**; AERIALS. No. 1 **2/9**; No. 2 **5/3**; WEBBING **4/-**; HAVERSACKS **5/6**; VALVES: A.R.P.12 **4/6**; A.T.P.4 **3/6**; SET OF FIVE VALVES **19/-.** Po tage on each item except valves **1/6** extra.
TYPE "18" RECEIVING PORTION ONLY with 4 VALVES SHORT WAVE 6-9 mc/s. **35/-.**
ATTACHMENTS for "18" TRANSMITTER-RECEIVERS Mark III. HEADPHONES **15/6** per pair. HAND MICROPHONES 4 a. **12/6.** AERIALS **5/9**; MORSE KEY **6/6**; VALVES: A.R.P.12 **4/6.** A.R.8. **7/6.** A.T.P.4 **3/6**; SET OF SIX VALVES **25/-.** Postage on each item except valves **1/6** extra.
RECORDING BLANKS. Brand new. Ready for cutting. 13in. **6/-** each or 15 complete in metal case, **£4.**
RESISTANCES. 100 assorted useful values; new wire end **12/6.** NEW.
CONDENSERS. 100 assorted Mica; Tubular etc. **15/-.** NEW.
CONTACTOR TIME SWITCHES. 2 impulses per sec., in case **11/6.**
REMOTE CONTACTOR. For use with above **7/6.**
QUARTZ CRYSTALS. TYPES F.T.241/243 2-pin. ½in. space FREQUENCIES (F.T.243), 5,706 kc/s. to 8,625 kc/s.
FUNDAMENTAL. (F.T.241), 20 mc/s. to 38.9 mc/s. (54th and 72nd Harmonics.) **4/6** each. Lists of available frequencies on request.
CRYSTAL CASES. F.T.241/243. **10/6** per dozen.
VARIOMETERS for Set No. "19," brand new, **21/-.**
VISUAL INDICATORS (10Q/4). Type 3 With 2 meter movements and two neons. New in cover. **12/-** each.
BOMBSIGHT COMPUTERS—Ex R.A.F. Wealth of gears, motors, blowers, etc. Precision made and new. **£3/12/6.**

Post or carr. extra. Full list Radio Books, etc. **3d.**

SOUTHERN RADIO SUPPLY LTD.
11, LITTLE NEWPORT STREET
LONDON, W.C.2 GERrard 6653

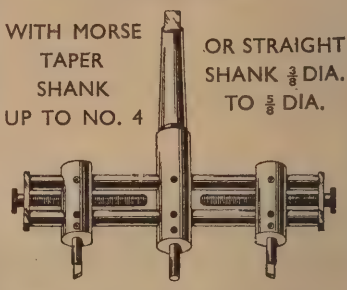
5WW—189 FOR FURTHER DETAILS.

BOOKS

"BASIC Mathematics for Radio and Electronics." By F. M. Colebrook, B.Sc., D.I.C.A.C.G.I. Revised and enlarged by J. M. Head, M.A. (Cantab.). Presents in readable form a complete course in basic mathematics from engineering students of all kinds and leads on to the more advanced branches of mathematics of increased importance to radio engineers. In this edition the chapter covering the application of mathematics to radio has been revised and enlarged, while new subjects covered include Stability, Linear Differential Equations, Elementary Statistics, Short Cuts to Numerical Calculations and an Introduction to Matrices. Will be invaluable to those without previous knowledge of the subject. 17/6 net from all booksellers. By post 18/6 from Iliffe Books Ltd., Dorset House, Stamford St., London, S.E.1.

"RADIO Interference Suppression as Applied to Radio and Television Reception." By G. L. Stephens, A.M.I.E.E. 2nd Ed. An up-to-date guide to the various methods of suppressing electrical interference with radio and television reception. Many practical applications are given, particular attention being paid to the problem of interference at television frequencies. Other chapters deal with the design and choice of suppressor components, methods of locating the source of interference, and suppression of the receiver itself. 10/6 net from all booksellers. By post 11/2 from Iliffe Books Ltd., Dorset House, Stamford St., London, S.E.1.

FOR ALL YOUR PANEL WORK WRITE FOR ILLUSTRATED BROCHURE OF PARALEX & LUFBRA ADJUSTABLE HOLECUTTERS



HOLES ACCURATELY BORED FROM 1in. DIA. TO 12½in. DIA.

AKURATE ENGINEERING Co. Ltd.
CROSS LANE, LONDON, N.8
TEL. FITZROY 2670

5WW—190 FOR FURTHER DETAILS.

"INTRODUCTION to Valves." By R. W. Hallows, M.A.Cantab., M.I.E.E., and H. K. Milward, B.Sc.Lond., A.M.I.E.E. Describes the principles, construction, characteristics and uses of most types of radio valves. The approach is simple and, as far as possible, non-mathematical, but the book provides the student with a thorough understanding of valves and how they work. 8/6 net from all booksellers. By post 9/4 from Iliffe Books Ltd., Dorset House, Stamford St., London, S.E.1.

"WIRELESS Servicing Manual." W. T. Cocking, M.I.E.E. This is the tenth edition of a book which since 1936 has been known to radio servicemen everywhere as a reliable, thorough and comprehensive guide to solving most of the problems that arise in the repair, maintenance and adjustment of the modern radio receiver. In the present edition a major addition is a chapter devoted to transistors and transistor sets. The author of "Wireless Servicing Manual" is well known to a wide circle of readers as former editor of "Electronic Technology" and now of "Industrial Electronics." His crisp lucid style makes this handbook of utmost value to the service man and amateur alike. 25/- net, 26/- by post from Iliffe Books Ltd., Dorset House, Stamford St., London, S.E.1.

"ABACS of Nomograms." By A. Giet. Translated from the French by H. D. Phippen and J. W. Head. Most engineers have made use of nomograms at some time in their careers, and are fully alive to the fact that they are a very convenient tool when the same formula has to be solved repeatedly for several sets of variables. It is fair to say, however, that only a small proportion of even those who habitually employ nomograms know how to construct them for their own use. Most of the comparatively small literature on the subject is written for mathematicians and is extremely difficult for the practical engineer to comprehend. This book is essentially practical, and not only demonstrates the many and varied applications of the abac of monogram, but shows how even those without highly specialized mathematical knowledge may construct their own charts. 35/- net from all booksellers. By post 36/- from Iliffe Books Ltd., Dorset House, Stamford St., London, S.E.1.

DAMAGED METER?
Have it repaired by Glaser

Reduce overheads by having your damaged Electrical Measuring Instruments repaired by L. Glaser & Co. Ltd.

INSTRUMENT REPAIRS

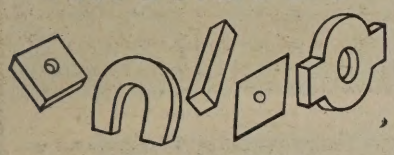
We specialise in the repair of all types and makes of Voltmeters, Ammeters, Microammeters, Multirange Test Meters, Electrical Thermometers, Recording Instruments, etc.

As contractors to various Government Departments, we are the leading Electrical Instrument Repairers in the industry For prompt estimate and speedy delivery send defective instrument by registered post, or write to Dept. W.W.:—

L. GLASER & CO. LTD.
96-100, Aldersgate Street, London, E.C.1
Tel.: Monarch 6822

5WW—191 FOR FURTHER DETAILS.

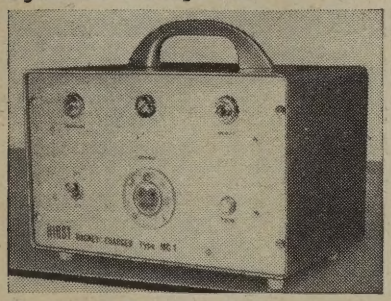
USING MAGNETS?



NOW—A UNIT SPECIALLY DEVELOPED FOR SMALL MAGNETISING WORK

New from Hirst is this portable self-contained MC1 Magnetising Unit. Especially designed for the charging of small magnets and assemblies, this simple mains-operated unit requires no skill in operation and is push-button controlled. Now magnetising becomes simple, efficient—and economic.

APPLICATIONS
Small Motors and Loudspeakers—Thermostats—Door Catches—Toy Magnets—Earphones—Cycle Dynamos—Relays etc.



Technical Specification
Supply—200/240 V 50 c/s.
Output Energy—40 joules.
Min. Fixture Resistance—1 ohm.
Size 10″ x 6″ x 6¼″. Weight 12 lbs.

PRICE £40
(fixtures if required extra)

Send for further details to :

HIRST ELECTRONIC LIMITED
GATWICK ROAD, CRAWLEY
SUSSEX. CRAWLEY 25721-5
Factories : Crawley & Ramsgate
5WW—192 FOR FURTHER DETAILS.

PROVED **The finest method for cleaning records**
Already over 200,000 enthusiastic users

THE "Dust Bug"
AUTOMATIC GRAMOPHONE RECORD CLEANER
PATENT No. 817,598

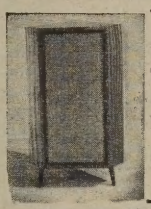
Price reduced to 17/6 (plus 2/11 purchase tax)
from your dealer or
CECIL E. WATTS LTD.
Consultant and Engineer (Sound Recording and Reproduction)
Darby House, SUNBURY-on-THAMES, MIDDX
5WW—193 FOR FURTHER DETAILS.

V.H.F. TX-Rx B44 Mk. II
60-95 Mc/s. using 14 midget valves (EF91 series), Rx is a double superhet, internal speaker 6in., also 12 volt power unit, voltage meter on front panel, Tx crystal controlled, all alloy chassis. **BRAND NEW** with handbook at the low price of 55/-, carr. 7/6. Alloy case 10/- extra.
EXPORT ENQUIRIES WELCOME.

19 SET RECEIVER POWER UNIT KIT 200-50 A.C. to 275 v. D.C. double choke filtered, 12 v. L.T. with connector to set (state 6 or 12) **45/-**, post 5/-; CONTROL BOX **6/-**, post 1/6. **MIKE & HEADSET 17/6.** Used **10/-**, P.P. 1/6.

CONNECTORS 6-6 pin long **5/-**. 12-12 pin long **8/6.** Post both 1/6. All brand new. **Variometers.** New **15/-**. Used **10/-**, post 2/6.

J. T. SUPPLY, 150 MEADOW LANE, LEEDS 11
5WW—194 FOR FURTHER DETAILS.



A.D *LOUDSPEAKER ENCLOSURES*
Corner 172 ARU Enclosure for Goodmans 12″ Speakers £16-10-0
A. DAVIS & CO.
(CABINET MAKERS)
3 Parkhill Place (off Parkhill Road), London, N.W.3
GULliver 5775
5WW—195 FOR FURTHER DETAILS.

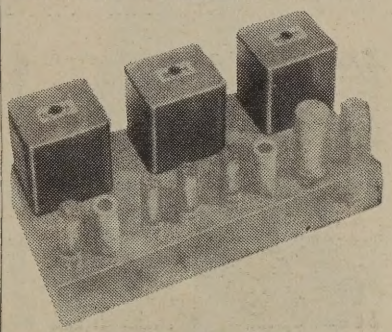
TANNOY
For sound sense
WEST NORWOOD LONDON SE27
GIPSY HILL 1131
5WW—196 FOR FURTHER DETAILS.

Radio Television & Electronics
Learn at home with the world's largest home study organisation. Brit. I.R.E.; City & Guilds; R.T.E.B.; Radio Amateurs, etc. Also Practical Courses with Equipment.
All Books supplied
Write for FREE prospectus stating subjects to
I.C.S.
(Dept 231), Intertext House, Parkgate Road, London, S.W.11
5WW—197 FOR FURTHER DETAILS.

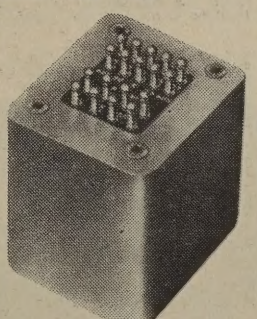
NEWS from Partridge

MATCHING AND MATCHLESS

The matchless quality of Partridge Transformers ensures their ready acceptance by designers—professional and amateur alike—for inclusion in equipment where the highest standards of performance and reliability are required. The illustration below shows a matching set of P.4200 Output Transformers and one P.4212 Mains Transformer used in a Mullard 10+10W Stereo Amplifier.

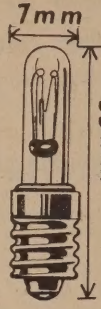


P4200 the best we've ever made!



Write for the newest issues of Partridge literature on the P4200 & P4212
Partridge Transformers Ltd.,
ROEBUCK ROAD, CHESSINGTON, SURREY
Tel.: Lower Hook 4353
5WW—198 FOR FURTHER DETAILS.

LAMPS FILAMENT 50v.
2.5w M.E.S.C.
at a fraction of manufacturers' prices.
£25.0.0 per 1000
Delivery ex stock, available in very large quantities for which special quotations are supplied on request.
Packed 100 per carton.
FINSBURY TRADING (London) LTD.,
12 STOKE NEWINGTON HIGH STREET,
LONDON, N.16. Telephone: CLissold 7352



5WW—199 FOR FURTHER DETAILS.

MAKING AN AMPLIFIER?
TRANSFORMERS FOR MULLARD AND OTHER AMPLIFIERS

OUTPUT TRANSFORMERS (Secondaries for 3.75 and 15 ohms)

T.142. ECL86's or ECL82's Push/Pull, 9,000 ohm. 20% tappings, **30/-**. P/P 2/6.
T.140. 3 watt amp. type A tape amp., 3 watt stereo, 5,000 ohm, **13/6**. P/P 1/6.

MAINS TRANSFORMERS (Primaries 240-220-200; 0-10v 50 c/s.)

T.317. ECL86's stereo 275-0-275 v., 160 mA., 6.3 v. 4 a., cT., 5 v. 2 a., **35/-**. P/P 3/3.
T.141. 3 watt 300-0-300 v., 60 mA., 6.3 v. 1 a., cT., 6.3 v. 1 a., **24/-**. P/P 2/3.
All transformers fully guaranteed, all shrouded fully except T.140.

SPECIAL OFFERS FOR TRANSFORMERS SETS T.162 and T.55, **64/-**.
T.317 and two 142's, **90/-**. T.140 and T.141, **35/-**. P/P 4/- on all.

SOUTHERN TECHNICAL SUPPLIES, 83 Station Road, Portslade, Sussex

5WW—200 FOR FURTHER DETAILS.

INDEX TO ADVERTISERS

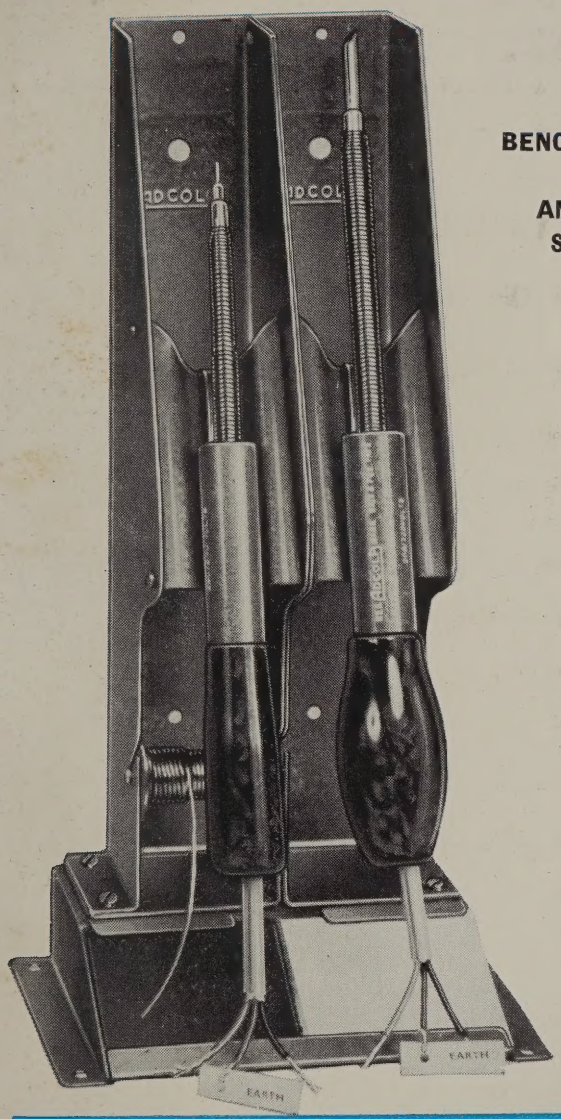
Appointments Vacant Advertisements appear on pages 119 to 125

	PAGE
Acoustical Mfg. Co., Ltd.	8
Adcola Products, Ltd.	Cover iii
A.D.S. Relays, Ltd.	11, 29
Adler, B. & Son	36
Advance Components, Ltd.	42, 43, 52, 53
Airmec, Ltd.	46, 63
Akurate Eng. Co.	128
Albatross Eng. Co.	128
Alpha Radio Supply Co., Ltd.	86
Anders Electronics, Ltd.	9
A.N.T.E.X., Ltd.	35
Armstrong Audio	28
Astralux, Ltd.	20
Audio Fair, The	80
Audix, B. B., Ltd.	108
Aveley Elec. Co., Ltd.	20
Avo, Ltd.	1
Bendix Corporation	49
Bentley Acoustical Corpn.	110
Berry's (Short Wave), Ltd.	38
Birmingham Sound Reproducers, Ltd.	39
Britain, Chas., (Radio), Ltd.	94
British Communications Corpn., Ltd.	2
British Electric Resistance Co., Ltd.	75
British Institute of Engineering Technology	26
British National Radio School	55
Bulgin A. F., & Co., Ltd. Edit.	107
Bullers, Ltd.	24
Cannon Electric Co. (G.B.), Ltd.	66
Cardross Eng. Co., Ltd.	44
Cathodeon, Ltd.	25
Clyne Radio, Ltd.	90, 91, 92, 93
C.R.E.I. (London)	56
Crystals & Components, Ltd.	86
Cursons, B. W.	126
Daly (Condensers), Ltd.	114
Davies, A., & Co.	129
Davis, Jack (Relays), Ltd.	18
Daystrom, Ltd.	3
Dependable Radio Supplies	108
Direct Photo Supplies	108
Dubilier Condenser Co. (1925), Ltd.	10
E.K. Electronics (I.A.), Ltd.	74
Electro Acoustic Development, Co.	126
Electronics (Croydon), Ltd.	97
Electro-Winds, Ltd	110
English Electric Valve Co., Ltd.	51
Erie Resistor, Ltd.	27
Fane Acoustics, Ltd.	28
Ferranti, Ltd.	37, 57
Ferrograph Co., Ltd.	12
Finsbury Trading Co.	130
Gardners Transformers, Ltd.	6
Gee Bros. (Radio), Ltd.	83
Gladstone Radio	78
Glaser, L., & Co., Ltd.	128
Goldring Mfg. Co., Ltd.	4
Goodmans Industries, Ltd.	5
Goodwin C. C. (Sales), Ltd.	110
Grampian Reproducers, Ltd.	80
Greenwood Electronics, Ltd.	17
Hall Electric, Ltd.	54
Harringay Photographic Supplies, Ltd.	126
Harris Electronics (London), Ltd.	84
Harris, P.	127
Harverson Surplus Co., Ltd.	78, 79
Hengstler, J. Co, Gt. Britain, Ltd.	50
Henry's (Radio), Ltd.	100, 101
Hirst Electronics	129
H. M. Stationery Office	80
Hornton's of Birmingham	74
H.P. Radio Services, Ltd.	55
Hunt, A. H. (Capacitors), Ltd.	19
Impex Electrical Co.	86
International Correspondence Schools	13, 34, 129
Irongate (M.O.), Co.	108, 109
Jackson Bros. (London), Ltd.	41
J. T. Supply	129
Keyswitch Relays, Ltd.	Cover ii
Kolectric, Ltd.	38
Lan-Electronics, Ltd.	47
Lasky's Radio, Ltd.	102, 103, 104, 105
Lawson Tubes	126
Leak, H. J., & Co., Ltd.	71
Ledon Instruments, Ltd.	78
Leevers-Rich Equipment, Ltd.	44
Levell Electronics, Ltd.	7
Lewis Radio Co.	127
Lexor Electronics, Ltd.	74
Light Soldering Developments, Ltd.	46
Linear Products, Ltd.	22
London Central Radio Stores	128
Lustraphone, Ltd.	32
Lyons, Claude, Ltd.	14, 33, 40
Malvyn Eng. Co., Ltd.	126
Marconi Company, Ltd.	68, 70
Marconi Inst., Ltd.	21
"Mechanical Handling Exhibition"	31
Mills, W.	118
Modern Book Co.	114
Modern Electronics (Retail), Ltd.	48
Moss Watson Co.	108
M.R. Supplies, Ltd.	55
Mullard, Ltd.	60
Multicore Solders, Ltd.	Cover iv
Newport Instruments, Ltd.	126
Nombrex, Ltd.	22
Olson Electronic, Ltd.	38
Parker, A. B.	46
Partridge Transformers, Ltd.	129
P.C.A. Radio	81
P.C. Radio, Ltd.	112
Pembroke College of Technology	47
Philips, N. V.	65
Pinnacle Electronic Products, Ltd.	15
Pitman, Sir Isaac, & Son, Ltd.	30, 48
Post Radio Supplies	114
Premier Radio Co.	90, 91, 92, 93
Proops Bros., Ltd.	82
Pye Telecommunications, Ltd.	61
Quartz Crystal Co., Ltd.	114
Radford Electronics, Ltd.	26
Radio & Electrical Mart	114
Radio & T.V. Components (Acton), Ltd.	96
Radio Clearance, Ltd.	98
Radio Component Specialists	106, 107
Radio Exchange Co., The	50
Radiospares, Ltd.	114
Radio Supply (M/c), Ltd.	76, 77
Rank Kalee	18
Reslosound, Ltd.	30
Robinson, F. C., & Partners, Ltd.	75
Rollet, H., & Co., Ltd.	126
R.S.T. Valve Mail Order Co.	99
Salford Elec. Inst. Co., Ltd.	34
Samsons (Electronics), Ltd.	111
Sankey, R.	108
Scientific Products	126
Service Trading Co.	84, 85
Sifam Electrical Instrument Co., Ltd.	127
Sinclair Electronics	72, 73
Smith, G. W. (Radio), Ltd.	87
Smith, H. L., & Co., Ltd.	32, 74
Sona Electronic Co.	115
Southern Radio Supply, Ltd.	128
Southern Technical Supplies	130
S.P.S. International, Ltd.	16
Stamford, A. L.	166
Stern-Clyne, Ltd.	90, 91, 92, 93
St. John's Radio	108
Tannoy, Ltd.	129
Taylor Electrical Insts., Ltd.	62
Technical Trading Co.	113
Telequipment, Ltd.	58
Thorn-A.E.I. Radio Valves & Tubes, Ltd.	64, 67
Tilley, D.	126
T.R.S. Radio	95
Turner, Ernest, Elec. Insts., Ltd.	45
Universal Book Co.	126
Vacuum Electronics, Ltd.	44
Valradio, Ltd.	46, 75
Vitality Bulbs, Ltd.	86
Vortexion, Ltd.	69
Watts, Cecil E.	129
Webber, R. A., Ltd.	46
Weymouth Radio Mfg. Co., Ltd., The	36
Wharfedale Wireless Work, Ltd.	48, 49, 110
Whiteley Electrical Radio Co., Ltd.	24
White, S. S., Dental Mfg. Co. (G.B.), Ltd.	23
Wilkinson, L. (Croydon), Ltd.	89
Winston Electronics	34
Wirecomp Electronics	88
Z. & I. Aero Service, Ltd.	116, 117

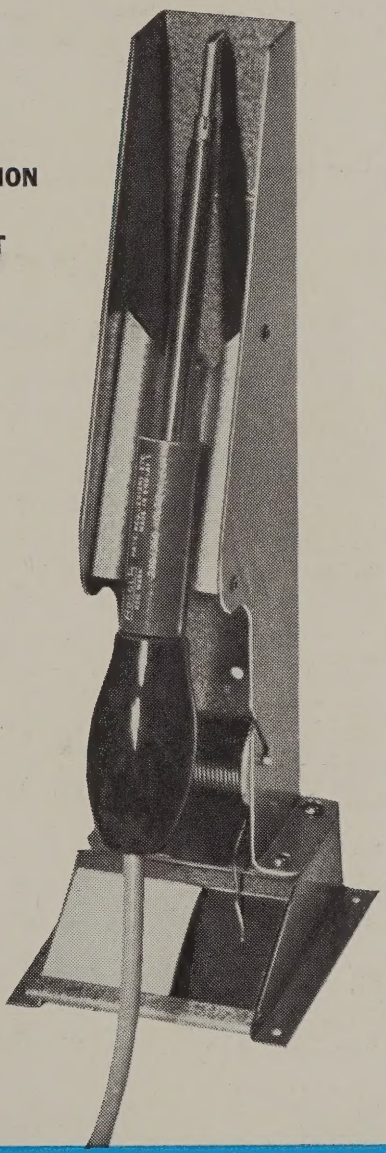
Printed in Great Britain for the Publishers, ILIFFE ELECTRICAL PUBLICATIONS LTD., Dorset House, Stamford St., London, S.E.1, by CORNWALL PRESS LTD., Paris Garden, London, S.E.1. *Wireless World* can be obtained abroad from the following: AUSTRALIA and NEW ZEALAND: Gordon & Gotch, Ltd. INDIA: A. H. Wheeler & Co. CANADA: The Wm. Dawson Subscription Service, Ltd.; Gordon & Gotch, Ltd. SOUTH AFRICA: Central News Agency, Ltd.; William Dawson & Sons (S.A.), Ltd. UNITED STATES: Eastern News Co., 306 West 11th Street New York 14.

ADCOLA
PRODUCTS LIMITED
(Regd Trade Mark)
SOLDERING EQUIPMENT

DESIGNS GIVING
TOTAL PERFORMANCE



FOR
BENCH LINE PRODUCTION
&
AMATEUR'S CIRCUIT
SOLDER JOINTING



For full information apply direct to

HEAD OFFICE SALES & SERVICE
ADCOLA PRODUCTS LTD
ADCOLA HOUSE, GAUDEN ROAD,
LONDON, S.W.4.

Telephones: MACaulay 4272 & 3101 *Telegrams: SOLJOINT, LONDON, S.W.4*

AUSTRALIAN ASSOCIATES; ADCOLA PRODUCTS PTY LTD., 673 WHITEHORSE ROAD, MONT ALBERT, MELBOURNE
AGENTS IN ALL LEADING COUNTRIES

5WW—002 FOR FURTHER DETAILS.

ERSIN MULTICORE SOLDER

5 5 5 5 5

Electronic equipment, however expensive, is only as reliable as the solder used in it. Ersin Multicore has been proved on production lines throughout the world to be today's most dependable and most economical cored solder.

5 CORES OF ERSIN FLUX ARE BEST

Savbit for Factories

Ersin Multicore Savbit Type 1 alloy containing 5 Cores of non-corrosive flux is supplied to factories at bulk prices on 7 lb. reels. 16 and 18 s.w.g. are the diameters most suitable for the majority of soldering processes. Supplies are also available on 1 lb. reels.

SAVBIT for Printed Circuits

A new 3-core SAVBIT *alloy with 362P flux has less than half the flux percentage of standard Ersin Multicore Solder. An exclusive agent PENTACOL combined with the flux promotes extra rapid spread.*

Savbit for the Service Engineer

Ask for the Size 12 SAVBIT *reel containing 145 ft. of 18 s.w.g.* SAVBIT *Type 1 alloy. Packed in Carton. Price 15/- each (subject).*

Savbit for the Small User

The Size 1 Carton contains approximately 40 ft. of 18 s.w.g. SAVBIT. *It is also supplied in 14 s.w.g. and 16 s.w.g. Obtainable from radio and electrical stores. Ersin Multicore 5-core Solder is also supplied in 4 specifications of Standard Tin/Lead alloys. Price 5/- each (subject).*

SPECIAL HIGH AND LOW MELTING POINT SOLDERS

H.M.P. (Melting point 296°C)
P.T. (Melting point 232°C)
L.M.P. (Melting point 179°C)
T.L.C. (Melting point 145°C)

Savbit in NEW handy dispenser

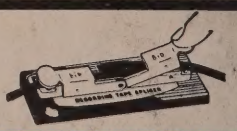
No tangling! Here's solder in a continuous coil which you can use direct from its handy free standing dispenser. Simply pull out—and solder! The dispenser contains 15 feet of 18 s.w.g. 5 core SAVBIT *Alloy suitable for TV, radio and electrical joints. Price 2/6 each (subject).*

Bib Wire Stripper and Cutter

This 3-in-1 tool strips insulation without nicking the wire, cuts wire cleanly and splits extruded plastic twin flex. Adjustable to most wire thicknesses, 3/6 each (subject).

Bib Recording Tape Splicer

Gives you a professional touch! This handy precision tool lets you edit tapes quickly and accurately—with no tape wastage and no post-editing clicks. The Bib Tape Splicer can be mounted directly on the tape deck. It uses all your odd lengths of tape, and pays for itself in tape saving over and over again. Bib value at 18/6!



ERSIN Multicore SOLDER

The finest cored solder in the world

Multicore Solders are covered by British Patent Nos. 433194, 675594, 794763, 721881.

MULTICORE SOLDERS LIMITED, MULTICORE WORKS, HEMEL HEMPSTEAD, HERTS. BOXMOOR 3636

CMMS.27

5WW—003 FOR FURTHER DETAILS.